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TINGITIDÆ FROM MALAYSIA AND MADAGASCAR (HEMIPTERA)

By C. J. DRAKE and M. E. POOR

Of Iowa State College, Ames

ONE PLATE

The present paper is based largely upon Tingitidæ from the Philippine Islands kindly presented to the writers by the late Charles Fuller Baker, of the University of the Philippines, and the Baker collection in the United States National Museum, Washington, D. C. It contains the descriptions of one new genus and sixteen new species, and notes on several other genera and species. Unless otherwise stated the types are in the Drake collection.

CANTACADER QUINQUECOSTATA (Fieber).

Taphrostethus quinquecostatus FIEBER, Ent. Mon. (1844) 41, pl. 3, figs. 18–22.

Cantacader quinquecostata STÅL, Enum. Hemip. 3 (1873) 117; DISTANT, Fauna Brit. Ind., Rhynch. 2 (1904) 123, fig. 88.

Two specimens: Mount Maquiling, Laguna Province, Luzon, *C. F. Baker;* Cadiz, Occidental Negros Province, Negros, *W. D. Pierce.*

SERENTHIA VICINALIS Drake.

Serenthia vicinalis DRAKE, Philip. Journ. Sci. 34 (1927) 311.

Four specimens: Imugan, Nueva Vizcaya Province; Baguio, Benguet Subprovince; Mount Maquiling, Laguna Province, Luzon. Mount Maquiling is the type locality.

SERENTHIA SEDALIS Drake.

Serenthia sedalis DRAKE, Philip. Journ. Sci. 34 (1927) 312.

One specimen, Mount Maquiling, Laguna Province, Luzon. Manila is the type locality.

Genus PERISSONEMIA novum

Head very short, with five spines. Bucculæ broad, contiguous in front. Rostrum long, the channel widening posteriorly. Metasternal canal long, prominent. Antennæ long, rather stout, indistinctly pilose, not widely separated at base; segments I and II short; III very long; IV long. Pronotum narrowed in front, pitted, transversely convex, tricarinate; calli deeply impressed; paranota narrow, areolate; collar strongly raised, very prominent, areolate; triangular process areolate. Elytra considerably longer than abdomen, when at rest strongly overlapping and jointly rounded behind, divided into the usual areas, the discoidal area reaching beyond the middle of elytra. Wings present. Legs long, slender.

Type of genus, *Perissonemia torquata* sp. nov.

Allied to the South American genus *Teleonemia* Costa, but distinguishable by the more slender antennæ, longer fourth antennal segment, deeply impressed anterior portion of pronotum, very strongly elevated and prominent collar, and differently formed paranota. The lateral carinæ in the genotype arise anteriorly on the disk or summit of the strongly swollen portion of pronotum.

The genus *Perissonemia* is here divided into two subgenera; namely, *Perissonemia* subgen. nov. (type, *torquata*) and *Ulonemia* subgen. nov. (type, *dignata*). In the former the hood is wanting, the collar strongly elevated and reticulate, the lateral carinæ short, and the outer row of areolæ on the anterior portion of the paranota with membranous margins (without marginal nervure). The subgenus *Ulonemia* is described below.

PERISSONEMIA (PERISSONEMIA) TORQUATA sp. nov. Plate 1.

Pronotum dark brown, slightly shiny, very strongly convex, coarsely pitted, indistinctly clothed with fine, short, golden hairs; collar lighter and subtruncate in front, very strongly raised. Median carina slightly more elevated in front, united with median nervure of collar, with one elongate cell behind collar. Lateral carinæ short, slightly converging posteriorly. Paranota peculiarly formed in front, there with the two inner areolæ bounded by a stout nervure and the three small outer areolæ with no distinct nervure along their membranous margins;

areolæ extremely small and indistinct on posterior portion. Elytra dark brown; costal area lighter, moderately broad, uniseriate, the areolæ large, hyaline, and iridescent; subcostal area triseriate in widest part. Pronotum and elytra with whitish exudation. Rostrum reaching slightly beyond middle of metasternum. Legs brown. Antennæ brown, segment I short, stouter and a little longer than II; III very long, twice as long as IV, the latter long.

Length, 3.25 mm; width, 1.85.

Holotype, male, Surigao, Mindanao (Drake collection); allotype, female, Butuan, Mindanao (U. S. Nat. Mus.); 2 paratypes taken with the allotype.

Subgenus ULONEMIA novum

Differs from the subgenus *Perissonemia* (type, *torquata*) in having long lateral carinæ, and differently formed paranota and collar. Hood present or absent. Paranota narrow, strongly reflexed and areolate, or only ridgelike and not areolate.

Subgenotype, *U. dignata* sp. nov.

PERISSONEMIA (ULONEMIA) DIGNATA sp. nov.

Moderately large, elongate, yellowish brown. Head dark ferruginous; spines very short, blunt, the median porrect. Eyes large, black, transverse. Bucculæ testaceous. Rostral channel deep, moderately widened posteriorly; rostrum reaching almost to end of channel, light brown, the tip dark; laminæ testaceous. Antennæ very long, rather slender, brown, somewhat shiny; segment I considerably stouter than, and nearly twice as long as, II; III practically straight, twice as long as IV, the latter long and more densely clothed with longer hairs.

Pronotum moderately convex, coarsely pitted, tricarinate, the disc pale brown; lateral carinæ long, converging posteriorly, slightly more raised and indistinctly areolate behind. Paranota narrow, very strongly reflexed, mostly biseriate, uniseriate behind. Collar strongly raised and reticulate, faintly convex at middle in front, slightly inflated and produced backward at middle so as to form a small oblique hood. Elytra testaceous, the areolæ hyaline; costal area uniseriate, the areolæ moderately large; subcostal area a little wider, almost entirely biseriate. Legs rather slender, brown.

Length, 3.05 mm; width, 1.

Holotype, male, allotype, female, Baguio, Benguet Subprovince, Luzon (Drake collection); 5 paratypes taken with the type (U. S. Nat. Mus.). One female, apparently the same species,

from Zamboanga, Mindanao. The color, shorter antennæ, and smaller hood separate this species from the new forms described below.

PERISSONEMIA (ULONEMIA) BORNEENSIS (Distant).

Teleonemia borneensis DISTANT, Rec. Ind. Mus. 3 (1909) 166, pl. 10, figs. 1, 1*a*.

Sandakan, Borneo, 11 specimens, *C. F. Baker*. The lateral carinæ are very sharply defined in some specimens, whereas in others they become almost obsolete. Certain specimens of the series agree perfectly with Distant's figure of the species. Six from Singapore, Straits Settlements, are slightly smaller and tend to have less-defined lateral carinæ, but they do not seem to differ enough to warrant a varietal description.

PERISSONEMIA (ULONEMIA) ILLUSTRIS sp. nov.

Small, slender, usually conspicuously marked with eight white spots (exudations). Head dark brown, convex above, the spines very short, stout, and pale brown. Antennæ moderately long; segment I rather long, slightly stouter, dark brown, and twice as long as II; III long, yellowish brown, two and one-half times as long as IV; IV slightly enlarged, dark brown. Body beneath dark brown, the sides with white exudation. Sternal laminæ widely separated and subparallel on meso- and metasternum, the rostrum extending to metasternum.

Pronotum very strongly convex, coarsely and deeply pitted, narrowed in front, tricarinate, brown to fuscous-brown, a white spot on each side in front and another on each side behind (exudations); median carina distinct; lateral carinæ faintly developed, becoming almost obsolete in front, strongly bowed inward behind disk, lateral margin indistinctly ridged. Elytra constricted beyond the middle, when in repose jointly rounded behind; brown, lighter behind, the apical margin fuscous; a spot on each side at base and another at apex of each discoidal area white (exudations); costal area very narrow, uniseriate; subcostal area wide, triseriate.

Length, 2.90 mm; width, 0.90.

Holotype, male, and allotype, female, Imugan, Nueva Vizcaya Province, Luzon (U. S. Nat. Mus.); paratypes, 6 males, taken with the type. In most of the specimens the elytra at the constriction behind are yellowish brown. The collar is distinctly raised but not so strongly as in *borneensis* Distant.

PERISSONEMIA (ULONEMIA) ELECTA sp. nov.

Elongate, slender, brown. Head dark reddish brown, the spines lighter, short, blunt. Eyes transverse, dark reddish brown. Antennal segment I about twice as long as, and much stouter than, II, the other segments wanting. Sternal laminæ testaceous, the channel deep and rather narrow, the rostrum yellowish brown and extending almost to end of sulcus. Body beneath brown. Legs slender, brown, the tips of tarsi dark. Wings longer than abdomen, slightly clouded.

Pronotum strongly convex, closely pitted, strongly narrowed in front, sharply tricarinate, the lateral carinæ distinctly converging posteriorly; all carinæ testaceous behind. Paranota very narrow, testaceous, strongly reflexed, biseriate in front, becoming narrower posteriorly, extremely narrow and nonreticulate opposite humeri. Posterior triangular projection reticulate. Hood small but very distinct, subtruncate in front, obliquely projecting posteriorly. Calli deeply impressed, dark brown. Elytra narrow, long, faintly constricted beyond middle; costal area narrow, uniseriate, the areolæ rather small, hyaline, and somewhat rectangular in outline; subcostal area narrower, biseriate, the areolæ very small; discoidal area long, extending beyond middle of elytra, narrowed at both base and apex, the outer boundary nearly straight, finely reticulate, widest near middle, there about six cells deep; sutural area more widely reticulate.

Length, 3.45 mm; width, 1.

Holotype, male, Baguio, Benguet Subprovince, Luzon.

This species is most closely allied to *Perissonemia dignatis* sp. nov., but readily separated from it by the narrow form, smaller hood, and very narrow posterior portion of the paranota. *Perissonemia assamensis* (Distant) has a much larger hood than either of the above species.

PERISSONEMIA (ULONEMIA) RECENTIS sp. nov.

Head brownish black, the eyes very large and black; median and anterior spines brown, very short, the posterior pair longer and yellowish. Bucculæ brown, contiguous in front, yellowish behind. Sternal laminæ yellowish, the channel deep, the rostrum reaching to metasternum. Body beneath dark brown, the legs yellowish brown. Antennal segment I short, stout, about twice as long as II, the latter slightly more slender; III long,

yellowish brown, slightly more than twice as long as IV; IV much darker, moderately incrassate.

Pronotum brown, the collar and part of carinæ and paranota testaceous; collar reticulate, only slightly elevated, faintly produced forward at middle. Paranota very narrow, testaceous and uniseriate in front, narrower and nonreticulate behind. Median carina mostly brown, slightly more elevated than lateral ones; lateral carinæ very distinct, slightly converging posteriorly. Elytra faintly constricted beyond the middle; costal area very narrow, uniseriate, the areolæ very small, testaceous, with a broad, transverse, fuscous band at middle; subcostal area narrow, testaceous, with fuscous band broader than in costal area, uniseriate in front and biseriate behind; discoidal area large, narrowed at both base and apex, impressed, with outer margin nearly straight; brown, the basal and apical parts testaceous; sutural area brown-fuscous. Wings longer than abdomen, clouded.

Length, 3.15 mm; width, 0.90.

Holotype, male, Singapore, Straits Settlements (U. S. Nat. Mus.); allotype, female, same locality (Drake collection). This species is somewhat atypical of the genus *Perissonemia*. The pronotum is broader in front and the collum not so strongly raised as in the other species described above. In addition to the above characters *recentis* is readily distinguished from the other members of the genus by the strikingly colored, bifasciate elytra. In the central portion of the darkened areas of the discoidal and apical portions of elytra some of the nervures are lighter.

Genus CYSTEOCHILA Stål, 1873

Logotype, *C. tingoides* (Motschulsky).

The genus *Cysteochila* Stål, Enum. Hemip. 3 (1873) 121 and 129, was erected for *Monanthia* ? *tingoides* Motschulsky, *M.* (*Physatocheila*) *sordida* Stål, and *C. caffra* Stål. The genera *Cysteochila* Stål and *Physatocheila* Stål are somewhat confused in the literature, and the characters employed by Stål for separating these two genera are rather weak. Distant, Fauna Brit. Ind. Rhynch. 2 (1904) 138, made *C. tingoides* (Motschulsky) the type of the genus *Cysteochila*. Bergroth, Revue Russe d'Entom. 17 (1917) 103 and 104, redescribed *C. tingoides* (Motschulsky) and made the genus *Bredenbachius* Distant a synonym of *Cysteochila*. He also disagree with Distant regarding the type of the

genus *Cysteochila* and stated that *sordida* must be regarded as the type.

The genus *Bredenbachius* Distant (type, *pictus* Distant) was erected for the intermediate forms of *Cysteochila* having one row of large areolæ in the costal area. Whether *Bredenbachius* should be treated as a genus or a subgenus or suppressed as a synonym of *Cysteochila* will depend upon the status of *C. tingoides* (Motschulsky). The writers have not seen examples of Motschulsky's species, but from the original description and the comments of Bergroth it would appear that *Cysteochila* with *tingoides* as genotype may include the species of *Bredenbachius*. Horvath, Arkiv för Zool. 17a (1925) 3, divides the genus *Cysteochila* Stål into the subgenera *Cysteochila* Horvath (type, *C. sordida* Stål) and *Parada* Horvath (type, *C. tæniophora* Horvath). The writers feel that *Parada* Horvath should be raised to generic rank; it may be separated from *Cysteochila* by the hood and strikingly different lateral carinæ. *Cysteochila elongata* Distant and *C. nexa* Distant from India are atypical of the genus *Cysteochila* and may represent a new genus.

CYSTEOCHILA PICTA (Distant).

Bredenbachius pictus DISTANT, Ann. Soc. Ent. Belg. 47 (1903) 50.

Four specimens from Mount Maquiling, Luzon, and 1 from Butuan, Mindanao. The writers are indebted to Mr. W. E. China for comparing a specimen from Mount Maquiling with Distant's type.

CYSTEOCHILA LECTA sp. nov.

Very similar to *C. picta* (Distant) in size, form, color, and marking, but readily separated from it by the extremely broad, transverse, brown band near the middle of elytra. Hood small, brown, a little higher and slightly more inflated than in *picta*. Paranota with the distal three-fourths brown, pale testaceous in front, about as high as median carina. Median carina more elevated than in *picta*, uniseriate; lateral carinæ as in *picta*. Sternal laminæ pale testaceous, the rostrum almost reaching mesometasternal suture. Antennæ brown, the terminal segment brownish black. Elytra with extremely broad, transverse, basal band (about one-third of elytra), the apical third and all of sutural area brown; costal area largely biseriate, a little broader than subcostal area, the latter biseriate. Wings embrowned.

Length, 3 mm; width, 1.05.

Holotype, female, Sandakan, Borneo (U. S. Nat. Mus.); paratype, female, taken with the type (Drake collection). The pronotum is strongly narrowed in front as in *picta*, and in *abundantis* sp. nov. described below.

CYSTEOCHILA ABUNDANTIS sp. nov.

Testaceous, with a few small fuscous spots. Head dark brown, with five short, blunt testaceous spines. Eyes large, reddish. Antennæ light brown, indistinctly pilose; segment I short, slightly stouter and slightly longer than II; III two and one-half times as long as IV. Bucculæ testaceous, closed in front. Sternal laminæ testaceous; rostrum brownish, the apex dark, extending to end of mesosternum. Body beneath brown.

Pronotum brown, strongly convex, strongly and abruptly narrowed in front, the humeri broad and prominent, hood very small, placed a little behind the anterior margin of pronotum, the latter faintly produced forward at middle; lateral carina reticulate, covered on disk by paranota, bowed outwardly on triangular process, curved inwardly at apex. Paranota broad, resting on dorsal surface of pronotum, not touching the median carina. Elytra testaceous, with a few small fuscous spots, slightly constricted beyond middle; costal area with one row of moderately large cells along the outer margin and with a partial inner row of much smaller cells; subcostal area a little broader, biseriate; discoidal area impressed, widest slightly beyond middle, there five areolæ deep, narrowed at both base and apex, the outer margin slightly sinuate. Legs brown, the tips of femora and basal two-thirds of tibiæ lighter.

Length, 3.25 mm; width, 1.05.

Holotype, male, and allotype, female, Tangkulan, Bukidnon Province, Mindanao (Drake collection); 30 paratypes, taken with the type and from Cuernos de Negros, Oriental Negros Province, Negros; Victorias, Occidental Negros; Iligan, Zamboanga, and Davao, Mindanao; Los Baños and Mount Maquiling, Luzon (U. S. Nat. Mus. and authors' collections).

CYSTEOCHILA VISENDA sp. nov.

Elongate, quite smooth in general appearance, testaceous, with fuscous markings. Antennæ rather long, brown, finely pilose; segment I short, slightly stouter and a little longer than II; III three times as long as IV. Rostral laminæ testaceous, the channel narrow and open behind, the rostrum extending be-

tween hind coxæ. Bucculæ testaceous, darker and contiguous in front. Eyes reddish.

Pronotum strongly convex, testaceous, more or less covered with whitish exudation, sharply tricarinate; with slightly raised triangular area in front, the anterior margin scarcely produced forward at middle; paranota broad, testaceous, resting upon dorsal surface of pronotum, touching lateral carinæ, sharply rounded behind; lateral carinæ slightly bowed inwardly on the disk, more widely separated and slightly bowed outwardly on triangular process; median carina more elevated on disk; all carinæ thick, testaceous on triangular process. Elytra testaceous, with fuscous markings, constricted beyond middle; costal area rather narrow, uniseriate; subcostal area wider, biseriate, with a transverse, brownish band near the middle; discoidal area long, extending beyond middle of elytra, slightly more than apical half brownish, widest near middle, there six areolæ deep, the outer boundary nearly straight; sutural area more widely reticulate behind, considerably embrowned, with a light-colored spot a little before the apex. Body beneath dark fuscous-brown. Legs testaceous.

Length, 3.60 mm; width, 1.

Holotype, male, Cuernos Mountains, Oriental Negros Provinces, Negros (Drake collection); allotype, female, taken with the type (U. S. Nat. Mus.). The very smooth general appearance, especially the paranota, separates this species at once from closely allied members of the genus.

CYSTEOCHILA BAKERI sp. nov.

Moderately large, brown-fuscous, with six conspicuous white spots on the elytra. Head black, with five short, blunt, brown spines. Bucculæ closed in front, brown, testaceous behind. Sternal laminæ testaceous, widely separated and cordate on metasternum. Rostrum brown, black at apex, extending to middle of metasternum. Hood very large, inflated, resting obliquely on the pronotum. Pronotum very coarsely pitted, moderately convex, tricarinate, each carina foliaceous and composed of one row of areolæ, the lateral carinæ concealed by inflated paranota except on triangular process, there faintly bowed. Median carina slightly more elevated on disk. Paranota strongly developed, inflated, convex above, resting upon, and extending a little beyond, lateral carinæ; brown, pale testaceous in front.

Antennæ moderately long, pale brown, smooth, apical segment darker; segment I short, slightly longer and stouter than

II, the latter obconical; III faintly enlarged at apex, about one and three-fourth times as long as IV, the latter slightly enlarged and moderately hairy. Elytra when in repose strongly overlapping and jointly rounded behind, a large spot at base of each elytron, a smaller spot at apex of discoidal area (extending into subcostal area), and a still smaller spot about half way between the latter and apex of elytra whitish (veinlets light in color and covered with white exudation); costal area moderately narrow, mostly uniseriate, a few extra cells in basal portion and sometimes two or three divided cells in constricted area; subcostal area broader, biseriate; discoidal area impressed, five cells deep in widest part slightly beyond middle, bounded by a strongly raised nervure, the outer margin sinuate.

Length, 3 mm; width, 1.20.

Holotype, female, Surigao, Mindanao (U. S. Nat. Mus.); allotype, male, Mount Maquiling, Laguna Province, Luzon (Drake collection). The latter specimen is somewhat teneral and much lighter in color. The white spots on the elytra make this insect very conspicuous. The elongate hood and differently formed paranota separate it at once from its congeners.

Genus DIPLOGOMPHUS Horvath, 1906

Diplogomphus HORVATH, Paris Bull. Soc. Ent. (1906) 296.

Haplotype, *D. capusi* Horvath.

The enormously developed humeral elevations (paranota) readily separate this genus and *Elasmognathus* Kirby from *Cysteochila* Stål, *Oncophysa* Stål, and *Physatochila* Stål. Bergroth, Revue Russe d'Entom. 17 (1917) 104, pointed out that *Bredenbachius* Distant is inseparable from *Cysteochila* Stål; he also transferred *Elasmognathus hewitti* Distant to the genus *Diplogomphus*. *Elasmognathus inusitatus* Drake and *E. napalensis* Distant also should be transferred to the genus *Diplogomphus*. The latter now contains five species; namely, *D. capusi* Horvath from China; *inusitatus* (Drake) from Luzon, Philippine Islands; *napalensis* (Distant) from India; *greeni* (Kirby) from Ceylon; and *hewitti* (Distant) from Borneo.

Genus ELASMOGNATHUS Fieber, 1844

Elasmognathus FIEBER, Ent. Mon. (1844) 90.

Haplotype, *E. helferi* Fieber.

The enormously and strikingly developed humeral elevations (paranota) which are deeply excavated behind are very different in form from the slightly larger, somewhat cylindrical, usually knob-tipped humeral elevations of the genus *Diplogom-*

phus Horvath. The genus *Elasmognathus* contains only two known species, *helferi* Fieber from India and the Philippines and *fieberi* Stål from Africa. The writers have a female specimen of *helferi* from Mount Maquiling, Luzon.

ONCOPHYSA NITENTIS sp. nov.

Very small, slender. Head black, convex above, with five very long, appressed, brownish black spines. Bucculæ broad, contiguous in front, back, testaceous behind. Rostral laminæ testaceous, the rostrum extending between middle coxæ. Antennæ rather short, indistinctly pilose, brown, segment I short, stout; II shorter and a little more slender; III two and one-half times the length of IV, the latter pilose and slightly enlarged towards apex.

Pronotum strongly convex, sharply tricarinate; collar testaceous, reticulate, slightly raised, deeply emarginate, roundly excavated in front; paranota strongly reflexed and resting tightly upon the dorsal surface of pronotum, practically touching the median carina in widest part, dark fuscous, smooth, shiny, the hind margin broadly curved; triangular process long, reticulate, testaceous; lateral carinæ testaceous and divaricating on triangular process, darker, mostly concealed on disk by paranota; median carina dark fuscous on disk, testaceous on triangular process; triangular portion of pronotum in front between paranota raised and testaceous. Elytra narrow, testaceous; subcostal area biseriate; discoidal area extending beyond middle of elytra, widest near middle; sutural area becoming more widely reticulate behind; costal area obsolete. Body beneath black. Legs brown.

Length, 3.45 mm; width, 1.

Holotype (female), Mount Banahao, Luzon (Drake collection). This is the first record of this genus in the Philippines. This new species is much smaller than the Australian species. *Oncophysa constantis* Drake from China belongs to the genus *Cysteochila* Stål.

DIPLOCYSTA NUBILA Drake.

Diplocysta nubila DRAKE, Philip. Journ. Sci. 32 (1927) 55.

Three specimens, Singapore, Straits Settlements.

DIPLOCYSTA NIMIA Drake.

Diplocysta nimia DRAKE, Philip. Journ. Sci. 32 (1927) 54.

Iligan and Zamboanga, Mindanao, and Samar. Cuernos Mountains, Negros, is the type locality. This species shows

some variation in color, some specimens being much darker than others. The female, viewed from above, looks no different from the male.

TRACHYPEPLUS BAKERI Drake.

Trachypeplus bakeri DRAKE, Philip. Journ. Sci. **34** (1927) 308.

Twelve specimens, Iligan, Mindanao. Type locality.

LEPTOYPHA HOSPITA sp. nov.

Pronotum brown, strongly convex above, very coarsely pitted, almost reticulate; collar distinct, reticulate, slightly excavated in front, median carina fairly distinct; lateral carinæ almost obsolete, constricted beyond middle. Elytra narrowed posteriorly, brown, the apical portion of discoidal area and nervelets of sutural area fuscous; costal area extremely narrow, very finely uniseriate; subcostal area much broader, biseriate; discoidal area broad, the outer boundary slightly sinuate and not prominent. Antennæ moderately stout, brown; segment I a little longer and stouter than II, the latter obconical; III distinctly enlarged at apex, less than three times as long as IV, the latter dark and hairy. Legs moderately stout, brown. Body beneath brownish black.

Length, 3 mm; width, 1.

Holotype, female, Penang Island, Straits Settlements. The very coarsely pitted pronotum separates this species at once from *L. capitata* Kiritshenko and the numerous American members of the genus.

ETEONUS SARPTUS sp. nov.

Broadly ovate, dark fuscous-brown, the legs, antennæ, and small basal portion and distal two-fifths of costal area of elytra largely testaceous. Head blackish, sparsely clothed with golden pubescence, the spines obsolete. Eyes very large, transverse, finely faceted. Antennæ moderately long, testaceous, the basal segment reddish brown, stouter than, and almost twice as long as, II; III long, slender, indistinctly pilose; IV wanting. Bucculæ light brown, contiguous in front, each side distinctly widened behind. Rostrum testaceous, reaching beyond middle of metasternum; rostral channel shallow, laminæ testaceous. Legs rather slender, testaceous, the tips of tarsi brown.

Pronotum very strongly convex above, deeply and coarsely pitted, sharply unicarinate, sparsely clothed with fine, short, recumbent, golden hairs; collar obliquely truncate in front, scarcely raised, coarsely pitted; calli impressed, black; lateral spines

(oppposite humeri) represented by indistinct teeth. Elytra broadest in front of middle (at apex of triangular pronotal process), constricted beyond middle, when at rest strongly overlapping and jointly rounded behind, the outer margin indistinctly serrate; costal area wide, with an extremely broad, transverse, fuscous-brown fascia (nervelet) in front of middle, mostly triseriate; subcostal area scarcely broader with three to four rows of areolæ; discoidal area bounded by a raised nervure, the outer boundary slightly sinuate, narrowed at both apex and base, widest beyond middle, there with a small brown spot and five areolæ deep; sutural area becoming more widely reticulate behind, with one row of regularly arranged large cells along the hind margin.

Length, 3.04 mm; width, 1.38.

Holotype, female, Surigao, Mindanao (Drake collection); allotype, male, taken with the type (U. S. Nat. Mus.). The much broader and triseriate costal area and much slenderer antennæ separate this species from *E. sagillata* Drake and Poor of India.

The writers have one specimen of *E. dilatus* Distant from Musha, Formosa, taken May 20, 1932. This specimen differs from Distant's figure of the type in not having conspicuous spines on sides of pronotum and in the different arrangement of areolæ in costal area; it agrees very well, however, with Takeya's figure of *dilatus,* Mushi 4 (1931) 82, pl. 9, figs. 11–14.

ETEONUS VIRTUTIS sp. nov.

Moderately large, sparsely clothed with fine, rather short, pale hairs. Head slightly convex above, dark brownish black, shiny. Eyes very large, dark. Antennæ moderately long, clothed with long hairs, brown, the first or the first two segments testaceous; segment I stouter and slightly longer than II; III faintly tapering towards apex, slightly more than twice as long as IV. Bucculæ brown, closed in front. Sternal laminæ brown, the rostrum extending to the metasternum. Body beneath brown, legs testaceous, the tarsi dark.

Pronotum strongly convex, coarsely punctate, slightly shiny, brown, the anterior margin truncate, testaceous. Paranota represented by a narrow ridge, slightly wider opposite humeri. Elytra broad, when at rest strongly overlapping and jointly rounded behind; costal area broad, mostly testaceous, triseriate, the areolæ hyaline, the outer nervure very strongly costate and dark brown; subcostal area biseriate in male and triseriate in female; discoidal area brown, moderately large, reaching at

least to middle of elytra, narrowed at both base and apex, the marginal nervure slightly sinuate; sutural area becoming testaceous posteriorly, the areolæ hyaline. Elytra much broader and more ovate in female than male. Wings much longer than abdomen, dusky.

Length, 3.25 mm; width, male, 1.32, female, 1.50.

Holotype, male, Mount Maquiling, Laguna Province, Luzon (U. S. Nat. Mus.); allotype, female, taken with the type (Drake collection). The strongly costate nervure along outer margin of elytra distinguishes this species from any of its congeners.

ETEONEUS VISENDUS sp. nov.

Very elongate, brown, the elytra uniformly tinged with yellow. Head reddish brown, with the median spine reduced to a small tubercle, the others wanting. Eyes very large, transverse, black, coarsely faceted. Antennæ very long, rather densely clothed with moderately long, whitish hairs; segments I and II very short, yellowish brown, subequal in length; III dark fuscous-brown, very long, straight, two and one-half times as long as IV, the latter faintly enlarged and about three times as long as the first two conjoined. Bucculæ closed in front. Rostrum very long, pale brown, tip dark, extending to base of abdomen. Legs very long, slender, testaceous, the tarsi dark.

Pronotum strongly convex, coarsely pitted, truncate in front, the triangular portion long, lighter; median carina distinct but not strongly elevated; collar distinctly reticulate, only slightly raised; calli impressed, shiny, reddish brown. Elytra very long, considerably longer than abdomen, slightly constricted beyond middle, when in repose jointly rounded behind; costal area broad, mostly triseriate, some places irregularly quadriseriate, the areolæ hyaline and not very large; subcostal area narrow, biseriate in male, triseriate in female; discoidal area reaching almost to middle of elytra, widest opposite apex of pronotal process, there six areolæ deep, narrowed both at apex and base; sutural area becoming more widely reticulated distally. Pronotum, head, and reticulations sparsely and indistinctly clothed with short, recumbent, pale hairs. Body beneath brown, the thorax darker. Male claspers strongly curved.

Length, 3.80 mm; width, 1.32.

Holotype, male, Imugan, Nueva Vizcaya Province, Luzon (Drake collection); allotype, female, taken with the type (U. S. Nat. Mus.). Many paratypes from the same locality. The greater length and longer appendages of this species are dis-

tinguishing characters. The female is a little broader than the male. The costal margin of elytra is fringed with short, fine, pale hairs.

PHYLLONTOCHILA RAVANA (Kirkaldy).

Sakuntala ravana KIRKALDY, Journ. Bombay N. H. Soc. 14 (1902) 298.

Phyllontochila ravana DISTANT, Ann. Soc. Ent. Belg. 47 (1903) 51; Fauna Brit. Ind. Rhynch. 2 (1904) 136, fig. 99.

Singapore, Straits Settlements, 1 specimen. Feeds on *Vitex trifolia* and is widely distributed in the Philippines.

PHYLLONTOCHILA PHILIPPINENSIS Distant.

Phyllontochila philippinensis DISTANT, Ann. & Mag. Nat. Hist. 9 (1902) 355.

Many specimens, Bauang, Union Province; Los Baños, Laguna Province; Zambales Province, Luzon. The authors are indebted to Mr. W. E. China for comparing some of these with Distant's type.

PHYLLONTOCHILA EROSA (Fieber).

Monanthia erosus FIEBER, Ent. Mon. (1844) 71, pl. 6, figs. 5–9.

Tingis erosa WALKER, Cat. Het. 4 (1873) 181.

Phyllontochila erosa DISTANT, Ann. & Mag. Nat. Hist. 9 (1902) 355.

Ammianus erosus DISTANT, Fauna Brit. Ind. Rhynch. 2 (1904) 137, fig. 100.

Mount Maquiling, Laguna Province, Luzon, 2 specimens. Widely distributed in the Philippines.

BELENUS DENTATUS (Fieber).

Monanthia dentata FIEBER, Ent. Mon. (1844) 71, pl. 6, figs. 2–4.

Phyllontochila dentata STÅL, Enum. Hemip. 3 (1873) 128; DISTANT, Fauna Brit. Ind. Rhynch. 2 (1904) 136.

Belenus dentatus DISTANT, Fauna Brit. Ind. Rhynch. 5 (1910) 116, fig. 58.

Mount Maquiling, Laguna Province, Luzon, 6 specimens.

RADINACANTHIA PRUDENTIS sp. nov.

Very slender, elongate. Head jet black, shiny, convex above, armed with five yellowish brown, blunt spines; posterior pair long, appressed, reaching almost to the base of antennæ; median shortest, blunt, bent downward; anterior pair more slender, directed downward and inward. Eyes large, black. Bucculæ broad, with a yellowish tinge, contiguous in front. Rostral channel wide, the rostrum reaching to middle of mesosternum. Orifice very prominent, testaceous. Antennæ very long, slender; segment I brown, rather long, twice as long as II; III testaceous,

more than twice as long as IV, the latter slightly enlarged and mostly dark fuscous.

Pronotum strongly convex, shiny, deeply and very coarsely pitted, brown, with a broad, longitudinal fuscous band on middle of each side; median carina with two distinct areolæ at base of collar, thence posteriorly with indistinct areolæ; lateral carinæ present only on the posterior triangular process, not very clearly defined; collar prominent, reticulate, very faintly produced forward at middle; paranota testaceous, present only on anterolateral margin, composed of two to four cells. Elytra testaceous, some of the nervures embrowned, faintly constricted beyond middle. Costal area not very broad, uniseriate, areolæ moderately large; discoidal area not quite reaching middle of elytra, narrowed at both base and apex, widest near middle, there five cells deep; sutural area becoming more widely reticulate posteriorly, the cells along inner margin becoming very large. Wings slightly shorter than elytra. Legs long and slender, pale brown, the femora considerably embrowned and shiny, the tarsi dark.

Length, 3.30 mm; width, 0.90.

Holotype, Ambalamadakana, Madagascar, and one paratype taken with the type. Differs from *R. reticulata* Hacker in having stouter antennæ, less-elevated median carina, and stouter, blunter, and appressed spines on head; from *tasmanica* Hacker in having anterolateral paranota and smaller discoidal area. This is the first record of this genus outside of the Australian Region.

HORMISDAS PICTUS Distant.

Hormisdas pictus DISTANT, Philip. Journ. Sci. 5 (1910) 60, pl. 1, fig. 1*a*, *b*.

Biliran Island, Philippines, 4 specimens.

HORMISDAS VICARIUS Drake.

Hormisdas vicarius DRAKE, Philip. Journ. Sci. 32 (1927) 56.

Many specimens, Cadiz, Occidental Negros Province, Negros, on *Urena lobata*, July 18, 1928, *W. D. Pierce*.

STEPHANITIS TYPICA (Distant).

Cadamustus typicus DISTANT, Ann. Soc. Ent. Belg. 47 (1903) 47; Fauna Brit. Ind. Rhynch. 2 (1904) 132, fig. 95.

Stephanitis typica HORVATH, Ann. Mus. Nat. Hung. 10 (1912) 325.

One specimen, female, Mount Maquiling, Laguna Province, Luzon. Other specimens are at hand from Ceylon, Java, and Hainan.

STEPHANITIS QUERCA Bergroth.

Stephanitis quercus BERGROTH, Ann. Soc. Ent. Belg. 64 (1924) 83.

Four specimens, Mount Maquiling, Laguna Province, and 1 from Baguio, Benguet Subprovince, Luzon. Bergroth states that this species feeds on oak which grows only in high altitudes.

STEPHANITIS NITORIS sp. nov.

Moderately large, broad, whitish testaceous, the elytra widening posteriorly and when in repose the tips widely separated; areolæ transparent. Pronotum slightly convex, pale brown, unicarinate; median carina strongly foliaceous, slightly higher than hood, the upper margin rather evenly rounded. Hood rather large, narrow, projecting forward beyond apex of head, compressed laterally, more inflated behind, twice as long as high. Paranota broad and long, four areolæ deep, strongly reflexed, the hind margin recurved.

Antennæ long, slender, indistinctly pilose, pale testaceous; segment I long, three times as long as II, the latter short; III less than twice as long as IV, the latter very long, distinctly pilose and faintly enlarged. Elytra broad, the outer margin rounded and finely serrate; costal area broad, with five rows of areolæ in widest part, two or three transverse veinlets in front of the middle embrowned; discoidal and subcostal areas jointly raised, forming a large tumid elevation, the subcostal area broad and biseriate; discoidal area not reaching middle of elytra, widest near apex, there triseriate; the hind margin truncate; the sutural area biseriate behind discoidal area. Wings clear, a little longer than abdomen. Bucculæ contiguous in front. Legs slender, pale testaceous.

Length, 3.35 mm; width, 2.25.

Holotype, male, and allotype, female, Mount Maquiling, Laguna Province, Luzon (U. S. Nat. Mus.); paratype, female, taken with the type. In addition the authors have one specimen from Occidental Negros Province, taken by W. D. Pierce. This specimen was preserved in alcohol and is slightly discolored and distorted, but apparently is *nitoris*. The shape of the elytra and the lack of prominent color markings separate this species from other members of the subgenus *Norba* Horvath. The veinlets are sparsely clothed with extremely fine hairs.

ACONCHUS URBANUS (Horvath).

Galeatus (Aconchus) urbanus HORVATH, Ann. Mus. Nat. Hung. 3 (1905) 565.

Pekalongan, Java, April, 1907, *F. Muir;* Kuala Lumpur, Selangor, Federated Malay States, September 10, 1922, *H. M. Pendlebury.*

DULINIUS CONCHATUS Distant.

Dulinius conchatus DISTANT, Ann. Soc. Ent. Belg. 47 (1903) 48.

Five specimens: Samarang, Java, *Edw. Jacobson;* Mount Maquiling, Laguna Province, Luzon; Occidental Negros Province, Negros.

Genus HOLOPHYGDON Kirkaldy, 1908

Holophygdon KIRKALDY, Proc. Linn. Soc. (Sydney) 23 (1908) 364; HORVATH, Treubia 8 (1926) 328.

Alloiothucha DRAKE, Philip. Journ. Sci. 32 (1927) 58.

Haplotype, *H. melanesica* Kirkaldy.

The genus *Alloiothucha* Drake is here suppressed as a synonym of *Holophygdon* Kirkaldy. This genus now contains four species, namely, *melanesica* Kirkaldy from Fiji, *artocarpi* Horvath from Java, and *philippinensis* (Drake) and *necopinata* (Drake) both from the Philippines. In addition to the latter two species the writers have a single specimen of *artocarpi* Horvath from Buitenzorg, Java, taken in 1926 by L. G. E. Kalshoven.

ILLUSTRATION

PLATE 1. *Perissonemia torquata* g. et sp. nov. (Drawing by M. E. Poor.) 19

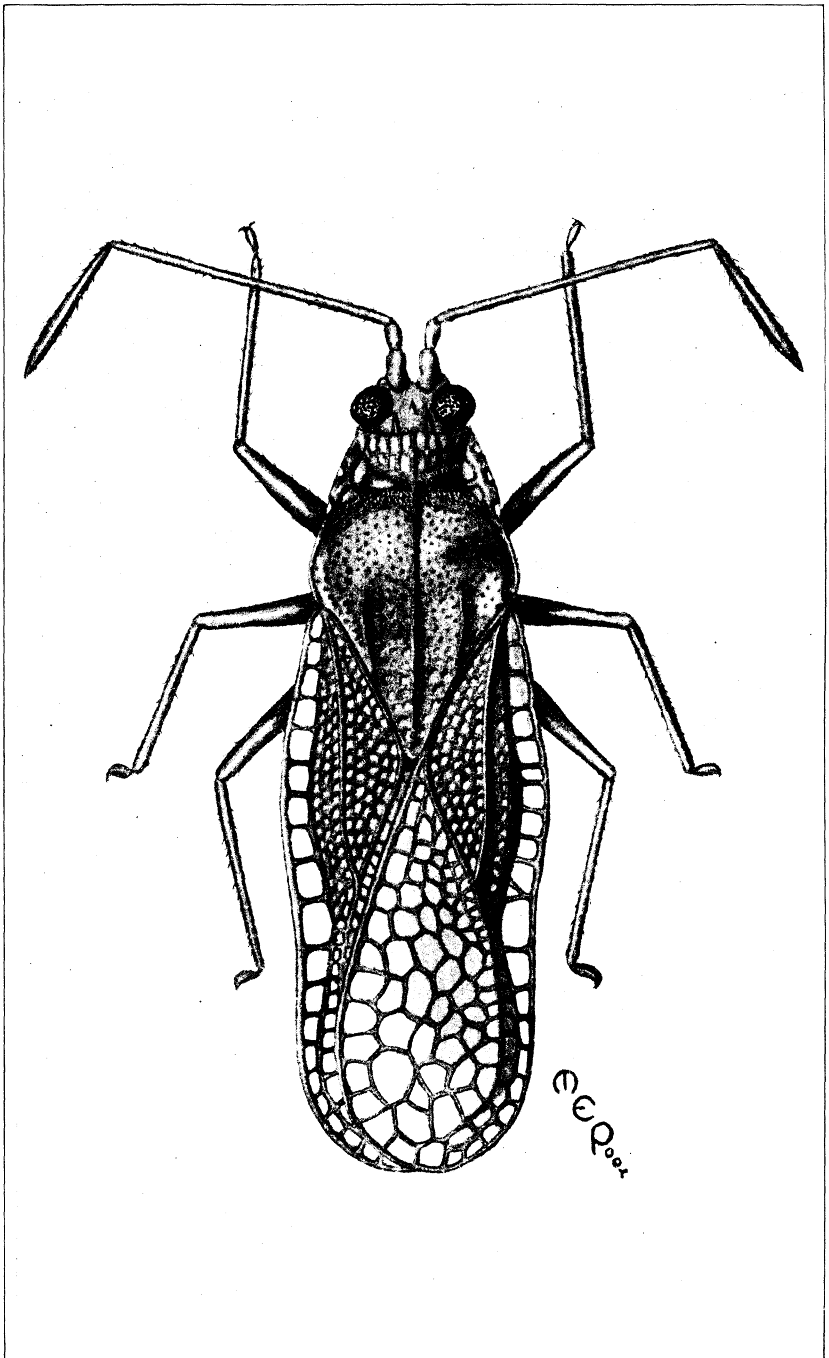

PLATE 1.

CHIRONOMIDÆ FROM JAPAN (DIPTERA), IX

TANYPODINÆ AND DIAMESINÆ [1]

By MASAAKI TOKUNAGA

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FIVE PLATES

In this report I discuss monographically the Japanese Tanypodinæ and supplement my previous paper on the Japanese Diamesinæ with descriptions of several species newly found in Honshu, central Japan.

I am greatly indebted to Dr. Hachiro Yuasa and Dr. Chukichi Harukawa for their kind help which made this report possible. Sincere thanks are extended to Dr. Teiso Esaki, Dr. Ryoichi Takahashi, Messrs. Kinji Imanishi, Tokichi Kani, Nanzaburo Omori, Tadao Masuda, Masaaki Morishita, Kazuo Shibuya, Noriaki Sugiyama, and Yoshihiro Yoshimura, and Miss Tamiko Ueno for material and literature.

The taxonomic system adopted in this paper is mainly that of Dr. F. W. Edwards. The morphological terminology is based on my previous papers. The antennal ratio is the ratio between the length of the ultimate segment and the length of the remaining segments, except the scape, taken together and, in the case of the male in the Tanypodinæ, between the length of the ultimate two segments together and the length of the remaining segments, except the scape, taken together. The leg ratio is the proportional length of the first tarsal segment of the leg to the length of the tibia. Abbreviations used in the text refer to Plate 2, fig. 17, and Plate 4, fig. 63.

TANYPODINÆ

About ten species of the subfamily Tanypodinæ have been recorded from Formosa by the late J. J. Kieffer (1918–1922), but from other parts of the Japanese Empire the family is quite unknown. Large collections from various localities, mainly Honshu, contain about twenty-four species, including about fifteen new species, that must be added to this subfamily of the Japanese chironomids.

[1] Contribution from the entomological laboratory of Kyoto Imperial University, No. 60.

Key to the genera of the Tanypodinæ.

1. R_{2+3} present and usually forked, except when R_1 and R_{4+5} are in contact ... 2.
   R_{2+3} absent, R_1 and R_{4+5} not in contact ... 7.
2. Fourth tarsal segment more or less cordiform, shorter than fifth ... 3.
   Fourth tarsal segment cylindrical, not shorter than fifth ... 4.
3. Anastomosed vein M_{3+4} + Cu_1 absent or very short, being less than one-sixth as long as free distal section of Cu_1 ... *Cœlotanypus* Kieffer.
   Anastomosed vein M_{3+4} + Cu_1 elongated, being from one-third to one-half as long as free distal section of Cu_1 ... *Clinotanypus* Kieffer.
4. Anastomosed vein M_{3+4} + Cu_1 present, crossvein m-cu absent ... 5.
   Anastomosed vein M_{3+4} + Cu_1 absent, crossvein m-cu present ... 6.
5. Anastomosed vein M_{3+4} + Cu_1 more than half as long as distal free section of Cu_1 ... *Procladius* Skuse.
   Anastomosed vein M_{3+4} + Cu_1 less than one-third as long as distal free section of Cu_1 ... *Tanypus* Meigen.
6. Costa much produced beyond end of R_{4+5} ... *Anatopynia* Johannsen.
   Costa not or scarcely produced beyond end of R_{4+5} ... *Pentaneura* Philippi.
7. Costa produced beyond end of R_{4+5} ... *Podonomus* Philippi.
   Costa not produced beyond end of R_{4+5} ... *Parochlus* Enderlein.

Of the above-mentioned eight genera of the Tanypodinæ only the following five have been known from Japan including Formosa: *Clinotanypus, Procladius, Tanypus, Anatopynia,* and *Pentaneura.*

Genus CLINOTANYPUS Kieffer

There have been known six species of this genus from Japan, of which three species were reported from Formosa by Kieffer ten or more years ago. They are all specific in coloration and easily distinguishable by this character.

Key to the Japanese species of Clinotanypus.

1. Wing with transversal band ... 2.
   Wing without transversal band ... 3.
2. All femora entirely yellow ... *C. formosæ* Kieffer.
   All femora blackish apically ... *C. decempunctatus* sp. nov.
3. Thorax blackish ... 4.
   Thorax yellowish ... 5.
4. Thorax entirely black ... *C. immaculatus* Kieffer.
   Thorax with paired yellow spots ... *C. japonicus* sp. nov.
5. Wing with marginal areas of r-m hyaline ... *C. lampronotus* Kieffer.
   Wing with marginal areas of r-m dark ... *C. sugiyamai* sp. nov.

CLINOTANYPUS FORMOSÆ Kieffer.

Clinotanypus formosæ KIEFFER, Ann. Mus. Nat. Hung. **14** (1916) 99; Philip. Journ. Sci. **18** (1921) 576.

This fly was collected at Anping and Takao, Formosa, by Sauter.

Female.—Body 2.8 mm in length, reddish in general appearance. Antennæ yellow, 14-segmented; ultimate segment with a long basal seta, slightly longer than preceding four segments together. Legs yellow; distal ends of tibiæ of fore and hind legs, distal end of first tarsal segment of foreleg, and second to ultimate tarsal segment of foreleg, distal ends of third tarsal segments of middle and hind legs, ultimate two tarsal segments of middle and hind legs all dark brown; first tarsal segments of all legs at least as long as the following four segments together; empodium short. Halteres whitish. Wing with a short apical brown band distad of crossvein and cephalad of M_{3+4}; r-m and first section of M_{3+4} and their marginal areas black; costa distinctly produced beyond end of R_{4+5}, almost reaching wing tip; anastomosed vein $M_{3+4} + Cu_1$ shorter than half of free Cu_1.

CLINOTANYPUS DECEMPUNCTATUS sp. nov.

This species is widely distributed in Honshu, Japan, and often collected at light trap.

Female.—Body 3.2 to 4.4 mm, ground color yellow; thoracic notum with dark markings on orange-yellow or deeply yellow vittæ; abdomen with brown bands; wing with a short brown band distad of crossvein, transversal veins and their marginal areas black.

Head, excepting black eyes, yellow; antennæ yellow, with scapes black, 14-segmented; ultimate segment subequal to preceding four segments together, with several basal setæ but without apical setæ; antennal ratio 0.3 to 0.35. Thorax yellow in ground color; scutum with ten black spots: one pair of small spots at shoulder parts, two pairs of elongate spots on lateral sides of yellowish median vittæ, one pair of large elongate spots on lateral sides of yellowish lateral vittæ, and one pair of small spots just caudad of lateral vittæ; scutellum yellow, brownish along cephalic margin; postscutellum pale brown, with three dark clouds on posterior margin; pleuron extensively yellow, with a dark spot near wing base; in darker specimens two pairs of elongate spots of scutum often fused longitudinally and postscutellum entirely black. Legs with ground color yellow; femoral tips and tibial tips of all legs dark brown; middle femur very broadly brown at middle part; hind femur broadly pale brown at middle; fore and middle tibiæ brown at basal half; distal end of first tarsal segment and ultimate four tarsal segments of foreleg black; distal half or more of third tarsal segment and ultimate two tarsal segments of middle leg black;

tarsal segments of hind leg as in middle leg in color; pulvilli absent; empodium short; tarsal spurs present on proximal three segments of middle and hind legs, absent on foreleg; proportional lengths of segments of legs 85 : 101 : 71 : 35 : 22 : 10 : 13 in foreleg, 87 : 92 : 59 : 26 : 15 : 9 : 2 in middle leg, and 78 : 100 : 65 : 36 : 23 : 10 : 14 in hind leg. Halteres white. Wing (Plate 2, fig. 16) with a short, broad brown band, base of radial veins and two transversal veins and their marginal areas black; but posterior transversal vein hyaline at middle; costa distinctly produced, but not reaching tip of wing. Abdomen yellow in ground color; tergum with a pair of brown clouds; terga, second, third, fourth, sixth, and seventh, each with a broad brown band on anterior part; fifth and eighth terga with bands more or less reduced, being narrower or interrupted at middle; cerci white; spermathecæ small, spherical, pale brown or yellow.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic female; Shimogamo, Kyoto; April 3, 1930.

Paratypes.—Alcoholic and dry females; Yamashina, Kyoto; September 5, 1932, and July 10, 1934; Imaizumi, Aomori Prefecture; July 27, 1935.

Type specimens.—Deposited in the entomological laboratory, Kyoto Imperial University; collected by Messrs. T. Masuda and M. Morishita and by myself.

This species is closely allied to the preceding Formosan species, *Clinotanypus formosæ* Kieffer, but distinctly different in the coloration of legs and scutum.

CLINOTANYPUS IMMACULATUS Kieffer.

Clinotanypus immaculatus KIEFFER, Ann. Mus. Nat. Hung. **14** (1916) 99–100.

This black species was collected at Tainan, Formosa.

Female.—Body shining, black, bare, 2.8 mm in length, wings hyaline, without bands or clouds. Head reddish brown. Antennæ reddish yellow, 14-segmented; ultimate segment equal in length to preceding two segments together, with a short apical stylet. Thoracic sclerites reddish brown. Legs brownish black; trochanters and proximal half of all femora, a narrow middle ring of middle tibia, a broad middle ring of hind tibia, proximal two-thirds of first tarsal segment of foreleg, proximal three tarsal segments of middle and hind legs all white; first tarsal segment hardly as long as following four segments together.

Halteres gray. Wings hyaline, without markings; two transversal veins hyaline as in longitudinal veins.

CLINOTANYPUS JAPONICUS sp. nov.

Male.—Body length 5.3 mm. Head reddish brown. Antennæ with proximal half including scapes reddish brown, distal half brown, without apical setæ; antennal ratio about 2.3. Mouth parts yellow. Thorax mainly black, shining; scutum with a pair of distinct yellow spots on shoulder parts; scutellum and postscutellum black; pleural membranes yellow; legs with coxæ black, trochanters pale brown; femora black, pale brown at base; tibiæ black, but hind tibia paler at middle. Tarsi yellowish on basal segments, dark brown on distal segments; first segment and proximal half of second segment of fore tarsus yellow, remaining parts brown or dark brown; proximal two segments of middle and hind tarsi yellow; remaining three segments brown or dark brown; tarsal spurs on proximal three segments of middle and hind legs, absent on foreleg; empodium short; pulvilli absent; relative lengths of segments of legs as follows: 80 : 103 : 63 : 32 : 22 : 10 : 12 in foreleg, 81 : 85 : 50 : 20 : 13 : 7 : 10 in middle leg, and 77 : 98 : 55 : 29 : 19 : 8 : 11 in hind leg. Halteres black. Wings (Plate 2, fig. 17) hyaline, without clouds; crossvein r-m straight, dark. Abdomen entirely dark brown, somewhat paler at side; hypopygium as in Plate 2, fig. 24.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Kinugasa, Kyoto; May 22, 1930; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is closely allied to *Clinotanypus nervosus* Meigen, but distinctly different in coloration of legs. Another allied species may be *Clinotanypus immaculatus* Kieffer, but in this species the thorax is not provided with paired yellow spots.

CLINOTANYPUS LAMPRONOTUS Kieffer.

Clinotanypus lampronotus KIEFFER, Ann. Mus. Nat. Hung. 14 (1916) 100.

This yellowish white species was found at Takao (altitude about 300 m), Formosa.

Male.—Body length about 5 mm, whitish yellow; wings hyaline, without markings. Antennæ 14-segmented, brownish, with scapes brownish yellow; antennal ratio about 2; maxillary palpi yellow. Thorax reddish brown; scutum whitish yellow, with

three reddish yellow vittæ. Legs whitish; distal ends of all tibiæ, distal end of first tarsal segments and remaining four tarsal segments of foreleg, three distal segments of middle leg, distal end of third tarsal segment, and two ultimate segments of hind leg dark brown; first tarsal segment of foreleg slightly shorter than tibia; empodium very short. Halteres whitish. Wings hyaline, without clouds; r-m oblique, black; first section of M_{3+4} hyaline as in longitudinal veins; costa produced, almost reaching tip of wing; stem of fMCu much longer than one-third of Cu_1. Abdominal terga of first three segments each with a large dark brown band; fourth tergum with a small cloud, fifth tergum with a transversal band; hypopygium brownish.

CLINOTANYPUS SUGIYAMAI sp. nov.

This distinctly marked species was collected at light.

Male.—Body about 4.8 mm in length; wing with a central black spot; thorax with black spots on reddish yellow vittæ; abdomen with dark brown bands.

Head mainly yellow, with eyes golden black, with a pair of small pure white spots between scapes and eyes. Antennæ 14-segmented, brown, with last segment pale brown; plumose hairs yellowish brown; antennal ratio about 4.1. Thorax extensively pure white; pronotum, pleural membrane pure white; scutum extensively pure white on shoulder parts and caudoscutal area, with orange yellow vittæ, and eight black spots; two pairs of small spots on lateral margins of median vittæ, one pair of large spots on lateral margins of lateral vittæ, one pair of very small spots just caudad of lateral vittæ; scutellum yellowish white on anterior part, yellow on posterior part; postscutellum orange yellow, dark on posterior part; pleural and sternal sclerites yellow; posterior notepisternum with a black spot; epimeron with an elongate brown cloud; sternepisternum with a broad transversal black stripe. Legs yellow in ground color with dark markings; distal ends of all femora and tibiæ black; fore tarsus entirely black; distal three tarsal segments of middle leg black; distal half of third tarsal segment and distal two segments of hind leg black; ultimate tarsal segments of all legs somewhat paler, being brown; middle part of femur and basal half of tibia of middle leg dark brown; proportional lengths of segments of legs 70 : 82 : 67 : 33 : 19 : 7.5 : 10 in foreleg, 77 : 75 : 55 : 24 : 12 : 7 : 9.5 in middle leg, and 70 : 85 : 58 : 30 : 18 : 7.5 : 9.5 in hind leg. Halteres white. Wing (Plate 2, fig. 18) with a dark central marking; r-m and base of R_{4+5}

black; first section of M_{4+5} hyaline; stem of fMCu about one-third of Cu_1. Abdomen yellow; second, third, and fourth terga, each with a black band at middle; fifth tergum with a small black median cloud; sixth with a narrow black band; first and seventh terga entirely yellow; eighth tergum brown along caudal margin; hypopygium brown, style bare on distal part, with a blunt setigerous lobe at lateroproximal part (Plate 2, fig. 25).

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Uzumasa, Kyoto; July 22, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. N. Sugiyama.

This distinct species is named in honor of the collector, Mr. N. Sugiyama; it somewhat resembles *Clinotanypus decempunctatus* in the coloration of thorax and abdomen, but the brown band of wing is absent and the first section of M_{3+4} is quite hyaline.

Genus PROCLADIUS Skuse

Including *Psilotanypus* KIEFFER and *Trichotanypus* KIEFFER.

Kieffer reported three species of this genus from Formosa; I add four species newly collected from Honshu. The satisfactory identification of the species of this genus is rather more difficult than in the other genera due to the close similarity in coloration. For the purpose of classification the length of the anastomosed vein (M_{3+4} + Cu_1) in relation to the free distal part of Cu_1, mediocubital ratio, may be one of the most useful characters, being comparatively constant for the species.

Key to the Japanese species of Procladius.

1. Macrotrichia of wing membrane completely reduced.
 Subgenus *Psilotanypus* Kieffer.[2]
 Macrotrichia of wing membrane at least present on tip of wing. (Subgenus *Procladius* Skuse.) .... 2.
2. Mesoscutum yellow in ground color .... 3.
 Mesoscutum brown or black in ground color .... 4.
3. Mediocubital ratio 0.6 to 0.7 .... *P. sagittalis* Kieffer.
 Mediocubital ratio about 0.8 .... *P. choreus* Meigen.
4. Scutal vittæ confluent .... 5.
 Scutal vittæ separated .... 7.
5. Mediocubital ratio about 1; female antennæ 13-segmented.
 P. insularis var. *transiens* Kieffer.
 Mediocubital ratio less than 1; female antennæ 14-segmented .... 6.
6. Wing with three small white spots on marginal area .... *P. iris* Kieffer.
 Wing without white spots on marginal area .... *P. crassinervis* Zetterstedt.

[2] The subgenus *Psilotanypus* is not known to be represented in Japan.

7. Wing with white spots on distal area........................ *P. insularis* Kieffer.
Wing without white spots on distal area.. 8.
8. Antennal ratio of male about 1.4; female antennæ 14-segmented.
P. lacteiclava Kieffer.
Antennal ratio of male about 1.9; female antennæ 13-segmented.
P. nipponicus sp. nov.

PROCLADIUS (PROCLADIUS) SAGITTALIS Keiffer.

This species is very common in Japan and often captured at light in summer and autumn.

Male.—Body 3 to 3.5 mm in length; thoracic ground color yellow or pale brownish yellow; wings largely clouded. Head with vertex dark brown, frontoclypeus yellowish. Antenna 15-segmented, with scape black, pedicel yellow, flagellum dark brown; antennal ratio 1.6 to 1.9; maxillary palpi dark brown. Pronotum yellow or pale brown; scutum yellow or pale brownish yellow, with four distinct dark brown lateral and brown median vittæ; caudoscutal area somewhat brown; scutellum yellowish; postscutellum dark brown; pleuron with sclerites dark brown, membranes yellow. Legs with coxæ dark brown; trochanters pale brown; femora brown or pale brown; tibiæ brown or pale brown, with distal ends black; proximal two tarsal segments yellowish white, with distal ends black; distal three tarsal segments black; empodium as long as claws; pulvilli absent; claws each with about four strong basal teeth; proportional lengths of segments of legs 52.5 : 65.5 : 50.5 : 23 : 17.5 : 12 : 87.5 in foreleg, 57.5 : 58.5 : 40 : 17.5 : 13.5 : 9 : 7.9 in middle leg, and 49.5 : 66.5 : 48 : 23 : 17 : 10.5 : 8.5 in hind leg; tarsal spurs on proximal two or three segments of middle and hind legs. Haltere with stem yellow, knob white. Wing dark brown on distal half, costal, subcostal, and anal cells, yellow on first radial and first median cells and proximal areas of cells R_5 and M_2; crossvein and first section of M_{3+4} black; mediocubital ratio 0.6 to 0.62. Abdomen black or dark brown; posterior margin of each tergum pale brown or yellow; style (Plate 2, fig. 29) somewhat triangular, basal lobe being very short, with a strong apical spine.

Female.—Body 2 to 3.2 mm in length, yellow in ground color. Antennæ entirely yellowish white, 13- or 14-segmented; ultimate segment with a small apical seta, longer than preceding four but shorter than preceding five segments together; antennal ratio 0.39 to 0.41. Scutellum with four distinct brown vittæ on yellow ground color. Legs as in male in color, often paler on proximal three tarsal segments; proportional lengths of

segments of legs 45.3 : 56 : 37 : 14.7 : 13.3 : 10 : 7.8 in foreleg, 52 : 55.7 : 35 : 16.3 : 12 : 7.8 : 7 in middle leg, and 44 : 59.3 : 39.7 : 20.3 : 14.3 : 8.7 : 7.7 in hind leg. Halteres white. Wings (Plate 2, fig. 20) with mediocubital ratio 0.64 to 0.68. Cerci (Plate 2, fig. 30) dark brown; spermathecæ (fig. 31) ovoid, brown, with hyaline neck region. Other main structures and color as in male.

Specimens.—Alcoholic males and females; Kyoto: Shimogamo, July 4, 1930; Yamashina, October 11, 1935; Yoshida, July 5, 1936; Mie Prefecture: Toba, August 5, 1934; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. T. Masuda and M. Tokunaga.

PROCLADIUS (PROCLADIUS) CHOREUS Meigen.

Male.—Body about 3.5 mm in length, yellowish in ground color. Head including mouth parts brownish yellow; antennæ also yellowish brown; antennal ratio about 1.75. Thorax pale brownish yellow; scutum with pale brown vittæ; caudoscutal area also pale brown; scutellum pale brownish yellow; postscutellum yellowish brown; pleuron largely yellow; sternal side brown. Legs mainly brownish yellow; distal ends of tibiæ and first tarsal segments darker; distal half of second tarsal segments and ultimate three segments of all legs brown; relative lengths of segments of legs as follows: 52 : 67 : 50 : 23 : 17 : 11 : 8 in foreleg, 59 : 60 : 40 : 18 : 13 : 9 : 8 in middle leg, and 52 : 69 : 48 : 23 : 17 : 10 : 8 in hind leg. Halteres yellowish white. Wings yellowish brown; two transversal veins and marginal areas dark; hyaline on costal, subcostal, first radial, and medial cells, proximal parts of distal radial and medial cells and cephalic part of anal cell; mediocubital ratio 0.82. Abdominal tergum brown on cephalic half or more and yellow on caudal half; hypopygium brown; style with a blunt basal projection.

Female.—Body about 2 mm in length, ground color yellow as in male. Antennæ 14-segmented: ultimate segment shorter than preceding five but longer than four segments together (58 : 65 : 53); antennal ratio about 0.4. Legs rarely with tarsal spurs on first segments of forelegs; proportional lengths of segments 45 : 55 : 36 : 18 : 14 : 10 : 7 in foreleg, 50 : 54 : 32 : 16 : 12 : 8 : 6 in middle leg, and 44 : 57 : 40 : 20 : 15 : 9 : 7 in hind leg. Wings with mediocubital ratio about 0.81. Coloration as in male.

Specimens.—Alcoholic male and females; Hachijo, Kyoto; May 25, 1930; Seto, Wakayama Prefecture; June 21 to 24, 1932;

deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

Wings are closely similar in coloration to those of *Procladius crassinervis* Zetterstedt, basal clear area being far broader than in the preceding species. Styles of the male hypopygium resemble those of *Procladius nipponicus* Tokunaga or are slightly longer.

PROCLADIUS (PROCLADIUS) INSULARIS (Kieffer).

Trichotanypus insularis KIEFFER, Philip. Journ. Sci. 18 (1921) 574–575.

This was collected at Daitotei, Formosa, by Sauter.

Male.—Body length 2.5 mm. Head reddish brown; antennæ yellowish gray, with plumose hairs brownish black. Thorax reddish brown; scutum with three dark vittæ, pruinose on cephalic half; scutellum yellow; postscutellum and sternum brownish black. Legs yellowish gray; distal ends of tibiæ and proximal three tarsal segments brownish black; ultimate two tarsal segments entirely brownish black; first tarsal segment slightly shorter than tibia and about twice as long as second tarsal segment. Halteres pure white. Wings clouded, with white spots, wing base white; three white spots: One at distal one-fourth of cell R_5, one at distal tip of cell M_2, and one on distal part of cell M_4; $M_{3+4} + Cu_1$ long, as long as Cu_1. Abdomen brownish black.

Female.—Body about 1.8 mm. Head and thorax brownish black; scutal vittæ black. Antennæ yellow. Legs dark brown; tarsal segment whitish; ultimate three tarsal segments and distal ends of proximal two segments dark brown. Other coloration mainly as in male.

In the variety *transiens* Kieffer the white spots of wings are more or less reduced, being rarely absent, the mesonotum is shining and without distinct vittæ, and the female antennæ are 13-segmented; the ultimate segment is a little longer than the preceding three segments together, with a basal seta and a short apical stylet. The color of the body is largely similar to that of the type.

PROCLADIUS (PROCLADIUS) IRIS Kieffer.

Trichotanypus iris KIEFFER, Ann. Mus. Nat. Hung. 14 (1916) 101.

This is found at Yentempo, Formosa.

Female.—Body length about 2 mm, mat reddish brown. Antennæ whitish, 14-segmented; ultimate segment very large, somewhat fusiform, with a long basal seta and a small apical stylet,

as long as preceding four segments taken together. Scutum with a black median vitta. Legs whitish; distal ends of tarsal segments, fifth tarsal segment and often fourth tarsal segment darker. Halteres white. Wings clouded on distal half, with three white spots on marginal area: one in cell R_5, one in cell M_2 and in cell M_4; two transversal veins black; $M_{3+4} + Cu_1$ shorter than Cu_1. Abdomen darker than thorax.

PROCLADIUS (PROCLADIUS) CRASSINERVIS Zetterstedt.

This fly was collected in various parts of Honshu in spring and summer.

Female.—Body 2.5 to 3.3 mm in length, largely black. Head with vertex black, frontoclypeus and mouth parts brown. Antennæ brown, 13- or 14-segmented; ultimate segments as long as preceding four segments together, with a small apical seta and five long basal setæ; antennal ratio about 0.34. Pronotum yellow, with a brown cloud on meson of each lateral half, scutum black, shoulder parts yellow; vittæ fused; scutellum dark brown; postscutellum black; pleural membranes yellow; pleural and sternal sclerites black. Legs with coxæ black, trochanters and femoral bases brown, other parts entirely dark brown; proportional lengths of segments 57 : 70 : 49 : 23 : 17 : 13 : 10 in foreleg and 55 : 74 : 52 : 24 : 18 : 12 : 10 in hind leg. Halteres with knobs white. Wings (Plate 2, fig. 22) darkly clouded on caudal and distal half, clear on basal area; mediocubital ratio 0.7 to 0.73. Abdomen black, yellowish on lateral sides; cerci (Plate 3, fig. 44) triangular; spermathecæ (Plate 3, fig. 45) oval, brown, with hyaline neck region.

Specimens.—Alcoholic females; Arashiyama, Kyoto; May 25, 1930; Mount Ryozen, Shiga Prefecture; June 3, 1930; Ikeda, Osaka; May 17, 1935; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. K. Shibuya and M. Tokunaga.

A female collected by Mr. K. Shibuya was found in a nest of a hunting wasp, *Crossocerus wesmaeli* Linden, being stored for the larva of the wasp.

PROCLADIUS (PROCLADIUS) LACTEICLAVA Kieffer.

Trichotanypus lacteiclava KIEFFER, Ann. Soc. Linn. Lyon **69** (1922) 41.

This fly was collected at Daitotei and Maruyama, Formosa, by Sauter.

Male.—Body length 3 mm. Antennæ and plumose hairs brown; fourteenth segment 1.3 times as long as preceding twelve seg-

ments together. Abdomen dark brown; four cephalic terga each with a white band; style dark brown.

Female.—Body about 2 mm, brown in ground color. Antennæ whitish, 13-segmented; last segment brown, as long as preceding five segments together, with a narrow long apical stylet. Scutum gray, pruinose, with three vittæ reddish brown. Legs brownish; articulations darker; fore tibia slightly longer than first tarsal segment. Halteres pure white. Wings clouded, whitish on proximal one-third of anal cell, entire costal and subcostal cells, and narrow areas beyond dark transversal veins.

PROCLADIUS (PROCLADIUS) NIPPONICUS sp. nov.

This fly is often collected at Kyoto in spring and summer at light.

Male.—Body 3.5 to 4 mm in length, dark brown in ground color. Head with vertex and frontoclypeus brown, mouth parts dark brown. Antennæ brown; antennal ratio 1.8 to 1.9. Pronotum pale brown; scutum brown, somewhat yellowish at shoulder parts; vittæ black, indistinct, somewhat fused; scutellum dark brown; postscutellum black; pleuron with membrane pale brown, sclerites brown; sternal side black. Legs with coxæ dark brown; trochanters and basal one-third of femora brown; distal two-thirds of femora black; tibiæ entirely black; first tarsal segments brown; other tarsal segments all black; proportional lengths of segments 48 : 63 : 47 : 22 : 17 : 12 : 9 in foreleg, 54 : 58 : 39 : 18 : 15 : 10 : 9 in middle leg, and 48 : 65 : 45 : 22 : 17 : 11 : 9.5 in hind leg. Halteres white. Wings with coloration as in the preceding species or in *Procladius crassinervis* Zetterstedt; mediocubital ratio about 0.75. Abdominal terga black, narrowly yellow along caudal margin. Hypopygium (Plate 2, fig. 21) black; style with a blunt basal lobe.

Female.—Body length 2.2 to 3 mm; coloration generally as in male. Head with vertex dark brown, frontoclypeus brown; frontal aspect largely yellow. Antennæ 14-segmented, yellowish brown; ultimate segment brown, with several basal setæ: antennal ratio about 0.35, varying from 0.32 to 0.44. Scutum often darker than in male, vittæ being completely fused as in *Procladius crassinervis* Zetterstedt. Proportional lengths of segments of legs as follows: 51.8 : 64.2 : 43.1 : 20 : 15.5 : 11.2 : 8.7 in foreleg, 60.2 : 63.1 : 36.2 : 17.8 : 13.4 : 9.2 : 8 in middle leg, and 50.7 : 67.4 : 44.3 : 22 : 16.2 : 10.6 : 8.7 in hind leg. Wings with mediocubital ratio about 0.7. Abdomen black; posterior margin of each tergum very narrowly yellowish; ultimate

segment somewhat paler; cerci (Plate 2, fig. 33) brown, subtriangular; spermathecæ (Plate 3, fig. 34) oval, dark brown, with swollen hyaline neck region.

Habitat.—Honshu, Japan.

Hollotype.—Male; Kibune, Kyoto; July 10, 1932.

Allotopotype.—Female; July 10, 1932.

Paratypes.—Males and females; Kyoto: Hachijo, May 23 to 30, 1930, and Kibune, July 10 and August 17, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly is closely allied to *Procladius lacteiclava* Kieffer in coloration, but differs in the 14-segmented female antennæ, the relative length of the ultimate segment of the antenna in both sexes, and the relative length of the fore tibia to the first tarsal segment. Another allied species may be *Procladius parvulus* Kieffer, from which the present species is easily distinguishable by the difference in the coloration of the legs.

Genus TANYPUS Meigen

Including *Protenthes* JOHANNSEN.

The following species is the only fly of this genus known from Japan.

TANYPUS PUNCTIPENNIS Fabricius.

Procladius formosanus KIEFFER, Suppl. Ent. 1 (1912) 31–32; Ann. Mus. Nat. Hung. 14 (1916) 101; Suppl. Ent. 5 (1916) 116.

Protenthes punctipennis MEIGEN, Philip. Journ. Sci. 18 (1921) 574; Ann. Soc. Linn. Lyon 69 (1922) 41.

This species is widely distributed in the Northern Hemisphere and has been recorded from Formosa, Tainan, Taihoku, and Daitotei, by Kieffer. There are three specimens from Honshu and Taihoku in our laboratory.

Male.—Body about 4.8 mm in length. Head brown, with eyes bare; antennæ pale brown, with scapes reddish brown, plumose hairs pale brown; ultimate segment with a small apical seta; antennal ratio about 2.3. Pronotum pale brown; scutum reddish brown in ground color, with three black vittæ; postscutellum black; pleural and sternal sclerites reddish brown; pleural membranes yellow. Legs with femora and tibiæ brown; tibial base and preapical ring yellowish brown; knee joints black; both ends of tibia black or dark brown; tarsus yellow in ground color, distal ends of proximal four segments black; ultimate

tarsal segments black; tarsal spurs and pulvilli absent; empodium short; claws simple; proportional lengths of segments of legs 51 : 61 : 51 : 26 : 20 : 14 : 11 in foreleg, 55 : 61 : 50 : 24 : 17 : 12 : 10 in middle leg, and 54 : 71 : 70 : 37 : 29 : 19 : 12 in hind leg. Halteres with stems brown, knobs yellow. Wing (Plate 2, fig. 19) with many brown clouds or spots; transversal veins and marginal areas black; first section of M_{3+4} hyaline at middle; cell R_5 with four or five double brown spots. Abdomen yellowish brown; posterior terga paler; each tergum paler on caudal half; hypopygium (Plate 2, fig. 28) dark brown; style with a thickened ridge along dorsomesal side.

Female.—Body 1.8 to 3.3 mm in length, yellow or pale brown in ground color. Head and mouth parts yellow; vertex brown; antennæ pale brown or yellow, with scapes brown, 15-segmented; ultimate segment subequal to preceding three together. Pronotum pale brown or brown; scutum yellowish, with four brown vittæ, a triangular brown cloud on caudal area; scutellum yellow; postscutellum brown; pleural and sternal sclerites pale brown or brown; pleural membranes yellow. Legs as in male in color, proportional length of their segments as follows: 33 : 39 : 33 : 16 : 12 : 9 : 7 in foreleg, 36 : 42 : 34 : 17 : 12 : 8 : 7 in middle leg, and 34 : 44 : 48 : 26 : 21 : 14 : 9 in hind leg. Abdomen yellow in ground color; each tergum with a narrow brown anterior band or uniformly brown; cerci (Plate 2, fig. 26) small, yellow; spermathecæ (Plate 2, fig. 27) spherical, each with hyaline neck region.

Specimens.—Alcoholic male and females; Taihoku, Formosa; November 16, 1924; Karo, Tottori Prefecture; July 3 to 5, 1931; Toba, Mie Prefecture; August 6, 1934; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. R. Takahashi and M. Tokunaga.

According to Kieffer the development of the beards of the male tarsus differs greatly among specimens from the same locality. Edwards (1931)[3] said that Kieffer's *Procladius formosanus* of Formosa is also the same species, the wings having been wrongly described as bare.

Genus ANATOPYNIA Johannsen

Including *Macropelopia* THIENEMANN and *Psectrotanypus* KIEFFER.

There are about five species of this genus, and they are distinctly specific in the coloration of the wings.

[3] Edwards, F. W., Diptera of Patagonia and South Chile, pt. 2 (1931) 239.

Key to the Japanese species of Anatopynia.

1. Legs with pulvilli .... 2.
   Legs without pulvilli .... 3.
2. Two median scutal vittæ distinct being dark........ *A. varia* Fabricius.
   Two median scutal vittæ indistinct being yellowish. *A. yoshimurai* sp. nov.
3. Wings with dark markings on cell R_5 .... 4.
   Wings without dark markings on cell R_5........ 5.
4. Wings with crossveins dark........ *A. nebulosa* Meigen.
   Wings with crossveins pale........ *A. kibunensis* sp. nov.
5. Wings without dark spots at ends of radial veins. *A. goetghebueri* Kieffer.
   Wings with dark spots at ends of radial veins........ *A. japonica* sp. nov.

ANATOPYNIA VARIA Fabricius.

Anatopynia brevicalcar KIEFFER is a synonym.

This fly is very abundant at Kyoto in the early spring. The immature forms are found on the muddy bottoms of still waters.

Male.—Body 3.8 to 9.5 mm in length, brown or pale brown in ground color; thorax with distinct dark brown vittæ; wings darkly clouded, with white patterns. Antennæ 15-segmented, with scapes and plumose hairs dark brown, flagellum pale brown; antennal ratio about 2.2; maxillary palpi 4-segmented (5 : 11 : 16 : 22). Thorax brown, with four dark brown scutal vittæ; scutellum pale brown. Legs pale brown, with knee joints darker; relative lengths of segments of foreleg, excepting proximal two segments, as follows: 92 : 112 : 73 : 38 : 28 : 17 : 11; that of middle leg 105 : 103 : 56 : 27 : 20 : 12 : 9; that of hind leg 97 : 114 : 82 : 46 : 32 : 20 : 11; tarsal spurs absent; both pulvilli and empodium large; claws simple. Halteres yellowish brown. Wings as in Plate 3, fig. 38. Abdomen pale brown; typically each segment with two brown setigerous bands, anterior band broader at meson, posterior band interrupted at meson; posterior four segments darker than anterior. Hypopygium dark brown; coxite with a blunt basal elevation; style slender, with a black apical spine (Plate 3, fig. 56).

Female.—Body length 3.2 to 7.2 mm; color as in male; abdominal segments without posterior bands. Antennæ 15-segmented, rarely 14-segmented; ultimate segment shorter than preceding three segments (54.4 : 73.9), but slightly longer than two segments together (54.4 : 51.3), with a small apical and several long basal setæ, antennal ratio varying from 0.18 to 0.21. Relative lengths of segments of legs as follows: 77.4 : 100.2 : 59 : 28.8 : 20.2 : 13.4 : 9 in foreleg, 97 : 91.8 : 43.8 : 21.8 : 15.6 : 10.2 : 8 in middle leg, and 86.2 : 99.4 : 65.8 : 35 : 25.5 : 16.8 : 9.5

in hind leg. Wings broader and darker than in male. Cerci somewhat rectangular; spermathecæ brown, with neck region (Plate 3, figs. 51 and 52).

Pupa.—Exuviæ 6 to 7.2 mm in length, brown; abdomen paler or hyaline on lateral parts. Thorax with several isolated setæ on tergum: one pair on pronotum, two on meson of mesoscutum, one cephalad of wing bases, one on scutellum. Prothoracic respiratory organs dark brown, straight, elongate, distinctly depressed, imbricate, with semicircular terminal part (Plate 1, fig. 13). Abdomen with characteristic marking on first tergum (fig. 12); chætotaxy of abdominal segments as follows: On tergum, first segment with a long seta on each laterocephalic part, three pairs of long setæ on posterior plate, and two setæ on each lateral margin (fig. 12), segments from second to fifth each with three pairs of long and two pairs of small setæ on caudal part, one pair of minute setæ on cephalic marginal thickening, and one slender seta on each laterocaudal part (fig. 10), sixth and seventh each with three pairs of small caudal setæ (fig. 11), other caudal segments without dorsal setæ; on sternum, from first to sixth each segment with three pairs of distinct setæ along caudal margin and one pair of minute setæ on cephalic marginal thickening (fig. 10), seventh with caudal setæ somewhat different in arrangement from preceding segment, median two pairs being set longitudinally (fig. 11), remaining segments without ventral setæ. Lateral swimming hairs, which are flattened and very long, only found on segments seventh, eighth, and ninth; five or six setæ on each lateral margin of seventh, five on eighth, and two on cephalic part of lateral swimming paddle of ninth segment. Each ultimate swimming paddle large, elongate, sharply pointed, fringed with delicate setæ basally and finely serrulate apically (figs. 14 and 15). Sheaths of genitalia of male elongate, a little longer than united part of paddles, while those of female very short, about half as long as united part.

Larva.—Body 8 to 9 mm in full-grown state, semihyaline, green or reddish green, with a delicate setal line on each side from prothorax to eighth abdominal segment, with large caudal tufts of hairs. Head brown; frontal sclerite very broad; chætotaxy as follows: Two pairs of setæ on cephalic part of frontal sclerite, three on dorsal side of each vertex dorsad of eye spot, and four on ventral side of each vertex caudomesad of eye spot; these setæ of head all simple, unbranched. Antennæ 4-segmented, basal segment very long, about six times as long as following three segments together, with a large sensory pore

on distal part, with bifid trichoid organ (Nebenborste and Blattborste) on distal membrane, second segment slender, with two sensory projections on laterodistal end; third segment minute, chitinized; fourth minute, conical, not chitinized (Plate 1, fig. 3). Clypeolabrum (fig. 2) membranous, several chitinized plates and various sensory organs; a narrow elongate plate of postclypeus on the dorsal side with a long simple hair at each lateral end, paired narrow plates (labraliæ?) ventrad of dorsal plate bare, a small narrow plate of preclypeus ventrad of paired plates also bare; membranous areas among these chitinized plates bluntly elevated: a dorsal narrow area just ventrad of dorsal plate bare, paired areas just ventrad of paired plates each with two trichoid sensillæ, a large membranous area of labrum proper ventrad of small plate with a pair of trichoid sensillæ and four pairs of peglike sensillæ; besides the above-mentioned sensillæ there are two pairs of porelike sensillæ just laterad of two narrow plates. Premandibles absent. Labium (Plate 1, fig. 6) consisting of a pair of serrate plates of mentum, each of which is provided with six to eight (usually seven) teeth, a small ventral lobe, which is a very thin structure and varies in shape in different specimens from trilobate to quadrilobate, a large dorsal lobe of labium proper, which arises from dorsal side of serrate plates, is constricted three parts and provided with a slightly chitinized longitudinal middorsal area and a very finely pubescent tip. Mandible (Plate 1, fig. 4) slender, with seven, varying from five to seven, lateral teeth including minute basal teeth, a long hyaline projection at base of apical tooth, two slender setæ and two porelike sensillæ on dorsal side. Hypopharynx (figs. 1 and 5) complicated in structure, mainly consisting of several chitinized plates and paired membranous lobes surrounding salivary cavity; a ventral thickly chitinized plate of salivia which is definitely serrate into four equal teeth, paired finely serrulate hyaline plates just laterad of salivia also applied on ventral side of hypopharyngeal projection, dorsal paired minutely serrulate narrow plates of hypopharynx proper applied on dorsal side of salivos and each with about eighteen teeth (varying from fifteen to twenty-one); these structures all supported basally by a fused pharyngea-lingulæ which is thickly chitinized and provided with three muscles at each lateral end; these muscles extending in different directions: one dorsocephalad, one straightly dorsad, and one caudoventrad; between salivia and hypopharynx proper there provided with paired membra-

nous lobes laterad of salivos, this lobe with four small sensillæ on distal end and two isolate sensillæ on dorsodistal surface. Cervix with a pair of slender setæ on ventral side. Throughout thorax and abdomen, excepting marginal setæ and caudal tufts of hairs, without distinct setæ; prothorax with typical pseudopods and two pairs of small setæ laterad of pseudopods; marginal setæ of thoracic region far smaller than in abdominal region. Abdominal lateral setæ well developed on segments from first to eighth; penultimate segment with two pairs of small setæ on laterodorsal side and paired large caudal tufts of hairs each of which consists of an elongate basal stem and about twenty long setæ (varying from fifteen to twenty); ultimate segment with a minute conical middorsal projection, three small setæ on each laterodorsal side, and two pairs of pointed anal gills; posterior pseudopods elongate, each with a small seta at middle and crowned with fifteen nonserrate hooklets (Plate 1, fig. 9).

Specimens.—Alcoholic males and females; Kyoto: Kitashirakawa, June 25, 1930, April 17, 1931, March 20 and April 7, 1932; Kibune, July 10, 1932; Miyake-Hachiman, July 2, 1936; Shiga, Mount Ryozen, June 3, 1930; Tottori, Mount Daisen, July 2, 1931; deposited in the entomological laboratory, Kyoto Imperial University; collected by Miss T. Ueno and M. Tokunaga.

According to Thienemann and Zavrel the immature forms of the present species belongs to the first type of the Tanypodinæ. The morphological terminology of the mouth parts of the larvæ used in this report and in those of Thienemann and Zavrel, may be compared as follows: Labrum proper, postclypeus, preclypeus, and labralia are termed "labrum" collectively; labium proper and mentum are termed "labium" collectively and the latter is termed "Paralabial-Kämme" of labium; salivia is termed "glossa;" hypopharyngeal lobe is termed "palpus hypopharyngealis;" hypopharynx proper is termed "Zahnleiste" of hypopharynx; differences in the other terms used are negligible.

ANATOPYNIA YOSHIMURAI sp. nov.

This fly was collected at the margin of stagnant water in Kyoto.

Female.—Body about 3.5 mm in length, yellow in ground color, with two yellowish brown lateral scutal vittæ; wings with characteristic dark bands.

Head with vertex brownish yellow; mouth parts and antennæ uniformly pale brownish yellow. Antennæ 15-segmented. Thorax yellow in ground color; scutum with two yellowish brown lateral vittæ and three pale brownish yellow lines on

cephalic area; scutellum yellow; postscutellum yellow, pale brownish on caudal margin; legs entirely pale brownish yellow; femora very obscurely brownish before yellow ends; both pulvilli and empodium present; relative lengths of segments of middle legs 97 : 100 : 56 : 26 : 19 : 14 : 9. Wing with two distinct dark transversal bands, crossveins and first section of M_{3+4} hyaline (Plate 3, fig. 39). Abdomen white in ground color; each segment, from second to eighth, with a pale brown median spot and two anterior pale brownish yellow clouds; hypopygium white, cerci as in Plate 3, fig. 54; spermathecæ yellowish, each with a distinct neck region (Plate 3, fig. 55).

Habitat.—Honshu, Japan.

Holotype.—Alcoholic female; Uzumasa, Kyoto; July 9, 1934; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. Y. Yoshimura.

This beautiful fly is named in honor of the collector, Mr. Yoshihiro Yoshimura; it is allied to *Anatopynia ornata* Meigen, but is distinctly different in the position of the wing band; in the allied species the distal band occupies the distal one-third of the wing area.

ANATOPYNIA GOETGHEBUERI Kieffer.

This fly was collected at light.

Male.—Body length about 3.5 mm. Head with vertex dark brown; frontoclypeus and mouth parts brown; antennæ 15-segmented, with scapes and plumose hairs dark brown, flagellar segments brown; antennal ratio about 1.7. Thorax pruinose, yellowish brown in ground color; scutum with median vittæ brown, lateral vittæ dark brown; scutellum yellowish brown; postscutellum dark brown. Legs yellowish pale brown, with coxæ brown, femoral distal ends somewhat darkish preapically; proportional lengths of segments of legs 60 : 75 : 58 : 27 : 19 : 12 : 9 in foreleg, 66 : 67 : 40 : 19 : 14 : 10 : 8 in middle leg and 60 : 75 : 55 : 26 : 20 : 13 : 9 in hind leg; pulvilli absent. Wing (Plate 3, fig. 37) with a distinct dark central spot on crossvein and basis of radial fork; distal one-third very slightly darkish. Abdomen yellowish brown, each tergum with a dark band along anterior margin; hypopygium as in Plate 3, fig. 48.

Female.—Body length about 3.2 mm, pale brown in ground color; thorax with four distinctly separated vittæ; wing with only a dark distinct central spot on crossvein. Head with vertex and mouth parts brown; antenna with scape brown; pedicel and flagellum brown, but basal part of each interme-

diate flagellar segment white; ultimate segment slightly shorter than preceding three segments together (60 : 63); antennal ratio about 0.2. Lateral scutal vittæ black; median vittæ short, brown at cephalic half and black at caudal half; scutellum and postscutellum pale brown. Legs uniformly brown; relative lengths of segments of legs 72 : 90 : 63 : 30 : 20 : 14 : 10 in foreleg, 90 : 86 : 49 : 24 : 16 : 10 : 9 in middle leg, and 72 : 94 : 70 : 33 : 25 : 16 : 11 in hind leg; pulvilli absent. Haltere white. Abdominal segments pale brown, each with a brown anterior band which triangularly extends caudad along middorsal line, narrowly white along caudal margin; penultimate segment entirely pale brown; ultimate, including cerci, white; spermathecæ pale brown, spherical, each with a very short neck region (Plate 3, fig. 49); cerci as in Plate 3, fig. 50.

Specimens.—Alcoholic male and female; Kyoto: Shimogamo, May 18, 1930, and Miyake-Hachiman, July 2, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by Miss T. Ueno and M. Tokunaga.

ANATOPYNIA NEBULOSA Meigen.

This is a large dark species which is often captured in the late autumn and early spring.

Female.—Body 5 to 6 mm in length. Head dark brown; appendages brown; antennæ 15-segmented; ultimate segment subequal in length to preceding four segments together; antennal ratio varying from 0.24 to 0.31. Thorax reddish brown, with three black scutal vittæ which are separated by pruinose lines; caudoscutal area dark brown; scutellum brown or somewhat paler; postscutellum black. Legs with coxæ reddish brown, trochanters and femora yellowish brown, tibiæ and tarsi brown or reddish brown, distal ends of tibiæ black; proportional lengths of segments of legs as follows: 92.7 : 123.3 : 84.7 : 50 : 32.7 : 23 : 16.3 in foreleg, 109.7 : 122 : 67.3 : 36 : 29.7 : 18 : 13.5 in middle leg, and 101.3 : 147 : 87.3 : 51:3 : 35.3 : 21 : 15.5 in hind leg. Wing as in Plate 2, fig. 23. Haltere white. Abdomen reddish brown, each segment with broad cephalic dark band; cerci (Plate 3, fig. 47) somewhat rectangular, yellow; spermathecæ (fig. 46) reddish brown, each with a short neck region.

Specimen.—Alcoholic females; Kibune, Kyoto, March 10 and May 7, 1932; Tsuta, Aomori, October 14, 1935; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

ANATOPYNIA KIBUNENSIS sp. nov.

This was collected at Kibune, Kyoto, in spring.

Female.—Body length about 4.2 mm. Head brown on vertex, pale brown on frontal aspect, mouth parts pale brown; antenna with scape and ultimate segment brown, other segments pale brown, 15-segmented; antennal ratio about 0.25; ultimate segment with an apical and two basal setæ. Thorax brown in ground color; scutum pruinose, with middle vittæ dark brown and lateral vittæ black, shoulder parts pale brown; scutellum and postscutellum brown; pleural membranes yellow. Legs with coxæ brown, trochanters pale brown; femur broadly brown at basal three-fourths, yellowish at both ends, dark brown preapically; tibia largely pale brown, dark brown at end; tarsus largely pale brown; pulvilli absent; relative lengths of segments of legs 95 : 119 : 82 : 45 : 33 : 21 : 16 in foreleg, 105 : 114 : 65 : 34 : 25 : 16 : 13.5 in middle leg, and 95 : 134 : 81 : 45 : 34 : 20 : 14 in hind leg. Wing resembling that of the preceding species (Plate 3, fig. 35). Abdomen entirely pale brown or brown; last segment, including cerci, yellowish white.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic female; Kibune, Kyoto, March 10, 1932; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly closely resembles *Anatopynia nebulosa* Meigen, but is easily distinguished by the yellow knee joints, pale crossvein and first section of M_{3+4}, and absence of a darkish cloud of the wing margin.

ANATOPYNIA JAPONICA sp. nov.

This fly was captured at a window.

Male.—Body about 3.5 mm in length, pale brownish yellow in ground color. Head with vertex brown, mouth parts and frontoclypeus pale brown; antennæ with scape brown, flagellum pale brown, 15-segmented; antennal ratio about 1.75. Thorax with four distinct yellowish brown vittæ on yellow scutum; scutellum yellow; postscutellum yellowish brown. Legs uniformly pale brown; knee joints somewhat darker; pulvilli and tarsal spurs absent; proportional lengths of segments of legs 75 : 93 : 67 : 32 : 22 : 14 : 9 in foreleg, 84 : 86 : 49 : 24 : 17 : 11 : 8 in middle leg, and 76 : 94 : 67 : 32 : 22 : 15 : 9.5 in hind leg. Halteres white. Wing (Plate 3, fig. 36) with three small dark spots at ends of three radial branches besides dark central spot over

crossvein and first section of M_{3+4}. Abdominal segment brown on cephalic half and yellow on caudal half; coxite and style as in Plate 3, fig. 53.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Hachijo, Kyoto, June 15, 1930; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This is closely related to *Anatopynia nugax* Walker, but in the allied species the leg ratio of the foreleg is 1.25, the wing is not provided with three dark spots at the ends of the radial veins, and the proximal two segments of the hind tarsus are provided with apical spurs.

Genus PENTANEURA Philippi

Including *Ablabesmyia* JOHANNSEN, *Isoplastus* SKUSE, *Pelopia* MEIGEN, and *Micropelopia* THIENEMANN.

This comparatively large genus includes a dozen or more Japanese species. The majority of these species are distinctly specific being provided with characteristic wing markings. They may be easily distinguished by the following key:

Key to the Japanese species of Pentaneura.

1. M_{3+4} ending far beyond level of end of R_{4+5} .... *P. minuta* sp. nov.
   M_{3+4} ending before level of end of R_{4+5} .... 2.
2. Wing with markings .... 3.
   Wing without markings .... 7.
3. Tibia and first tarsal segment each with a dark median ring. *P. monilis* Linnæus.
   Tibia and first tarsal segment without median rings .... 4.
4. Postscutellum whitish or yellowish .... *P. octopunctata* sp. nov.
   Postscutellum brownish or darkish .... 5.
5. Wing with at least one transversal band .... 6.
   Wing without complete transversal band .... *P. monticola* sp. nov.
6. Wing with one transversal band .... *P. fusciclava* Kieffer.
   Wing with two transversal bands .... *P. maculipennis* Zetterstedt.
7. Postscutellum whitish or yellowish .... 8.
   Postscutellum brownish or darkish .... 10.
8. Mesoscutum with dark or brown spots .... 9.
   Mesoscutum without dark or brown spots .... *P. alba* sp. nov.
9. Mesoscutum with eight dark spots .... *P. japonica* sp. nov.
   Mesoscutum with four dark spots .... *P. melanops* Meigen.
10. R_{2+3} incomplete, atrophied before costal margin .... 11.
    R_{2+3} complete, ending on costal margin .... 13.
11. Mesoscutal median vittæ distinct, as dark as lateral vittæ. *P. longipennis* sp. nov.
    Mesoscutal median vittæ indistinct, paler than lateral vittæ .... 12.

12. First and second abdominal terga without bands........ *P. divisa* Walker.
First and second abdominal terga each with a dark band.
P. kyotoensis sp. nov.
13. Fourth abdominal tergum with a dark band...... *P. multifascia* sp. nov.
Fourth abdominal tergum without dark bands...... *P. gracillima* Kieffer.

PENTANEURA MINUTA sp. nov.

This may be one of the smallest species of the Tanypodinæ, usually less than 2 mm in body length.

Male.—Body length about 2 mm, ground color pale brown. Head with vertex brown, frontoclypeus and mouth parts pale brown, eyes pubescent, widely separated above from each other. Antennæ 15-segmented, with antennal ratio about 0.39. Maxillary palpi slender, 5-segmented (14 : 18 : 25 : 39 : 60). Scutum pale brown, with four brown vittæ, the median pair long reaching caudal margin of scutum; scutellum pale brown; postscutellum brown; pleuron and sternum uniformly pale brown. Legs also entirely pale brown; proportional lengths of segments as follows: 21 : 16 : 18 : 6 : 5 : 4 : 3 in foreleg, 28 : 16 : 24 : 9 : 6.5 : 4.5 : 4 in middle leg, and 25 : 22 : 24 : 11 : 8 : 5.2 : 4.2 in hind leg. Halteres pale brown. Wings (Plate 3, fig. 40) with two transversal veins located at basal one-fourth of wing length, without R_{2+3}, R_1 and R_{4+5} extending closely in contact with each other, R_{4+5} ending far before level of tip of M_{3+4}, proximal section of M somewhat atrophied. Abdomen entirely pale brown, with styles of hypopygium slender.

Female.—Body 1 to 1.2 mm in length, dark brown; abdomen short, oval; general appearance *Culicoides*-like.

Head blackish, with mouth parts pale brown. Antennæ pale brown, 12-segmented; ultimate segment shorter than preceding three segments together (24 : 27), with a long apical seta, four slender preapical sensory setæ, and several basal verticils; intermediate flagellar segments each with several long verticils and two long trichoid sensillæ; antennal ratio about 0.3. Maxillary palpi elongate, 5-segmented (1 : 2 : 5 : 6 : 10). Scutum dark brown, pruinose along foveæ, with four black vittæ; scutellum brown; postscutellum and pleural and sternal sclerites black; pleural membranes brown. Legs uniformly brown; proportional lengths of segments of foreleg 21 : 16 : 12 : 5 : 5 : 4 : 3.5; relative length of femur to tibia 30 : 17 in middle leg and 35 : 22.5 in hind leg (tarsi broken off). Halteres brown. Wings far broader than in male. Abdominal terga dark brown; sterna brown.

Habitat.—Honshu, Japan.

Holotype.—Male; Kibune, Kyoto; July 1, 1930.

Allotype.—Female; Uzumasa, Kyoto, October 29, 1934.

Paratype.—Female; Uzumasa, Kyoto; October 29, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. Y. Yoshimura and M. Tokunaga.

This species is closely allied to *Pentaneura dubia* Meigen, in which, however, the male antennæ are 16-segmented, with the antennal ratio about 0.7, and the proportional length of the first tarsal segment to the tibia is 0.8 in the foreleg, 1.5 in the middle leg, and 1.1 in the hind leg in both sexes.

PENTANEURA MONILIS Linnæus.

Tanypus monilis, LINNÆUS, Philip. Journ. Sci. 18 (1921) 574; Ann. Soc. Linn. Lyon 69 (1922) 41.

This is widely distributed in the Northern Hemisphere and has been recorded from Anping, Taihoku, and Daitotei, Formosa. The adults of both sexes are very common at Kyoto, being captured at light almost throughout spring, summer, and autumn.

Male.—Body length 3 to 4.5 mm; coloration variable from pale brown to dark brown; wings with many irregular dark clouds; legs with many black rings.

Head with vertex yellowish brown, frontoclypeus yellow or pale brown. Antennæ 15-segmented, with scapes dark brown or black, flagellum pale brown; plumose hairs bicolored, proximal hairs pale brown, and distal hairs black; antennal ratio 2.09 (1.92–2.2). Scutum yellowish pale brown in ground color, with four reddish or dark brown vittæ; caudoscutal area dark brown; scutellum white; postscutellum brown or black; pleural and sternal sclerites dark brown; pleural membranes yellowish white. Legs yellowish white, with knee joints white; femur with a preapical dark ring, sometimes brownish on basal half; tibia with three dark rings, on basal, middle, and apical parts; first tarsal segment with two dark rings, on middle and apical parts; following two segments dark at each end; fourth segment dark brown at distal half or brown on basal half and black on distal half; ultimate tarsal segment entirely brown or black; tarsal spurs on proximal three segments of all legs; claws simple; empodium short; pulvilli absent; proportional lengths of segments as follows: 55.4 : 68.2 : 56.2 : 36.4 : 27 : 17.6 : 9 in foreleg, 63.8 : 62.2 : 48.2 : 29.6 : 22.4 : 14.8 : 8.6 in middle leg and 54.5 : 70.5 : 60.5 : 36.8 : 27.5 : 17.3 : 9 in hind leg; leg ratio

of three pairs as follows: 0.82 (0.77–0.87), 0.78 (0.73–0.83), and 0.86 (0.78–0.91), respectively. Halteres white. Wings (Plate 4, fig. 66) with many dark spots; crossveins h, r-m, m-cu, base of radial branches, and distal ends of three radial veins and their marginal areas black; dark brown clouds: two or three in cell R_5, two in M_2, two in M_4, and five or six in anal cell; first section of M_{3+4} hyaline. Abdomen usually whitish or yellowish; posterior five or three terga more or less brown at middle or at side or entirely clouded; hypopygium (Plate 4, fig. 80) with long slender styles, which are usually pubescent on proximal two-thirds and each provided with a chitinized apical projection and a preapical cuplike hyaline appendage.

Female.—Body 1.5 to 3 mm in length, coloration generally as in male. Antennæ with scapes dark brown, flagellum yellow or pale brown; 12-segmented; ultimate segment with an apical stylet, a short apical seta, and several long basal setæ; subequal in length to preceding three segments together (47.8 : 47.5); antennal ratio 0.28 (0.24–0.32). Scutal vittæ usually more distinct than in male, being reddish or dark brown on pale brown or yellow ground color. Legs with coloration as in male; proportional lengths of segments as follows: 45.9 : 52.9 : 43.6 : 26.7 : 19 : 13 : 7.9 in foreleg, 55.1 : 54.5 : 43.2 : 24.2 : 17.8 : 11.8 : 7.6 in middle leg, 49.1 : 65.2 : 55.8 : 31 : 22.6 : 14.6 : 8 in hind leg; leg ratio of foreleg 0.83 (0.79–0.85), of middle leg 0.8 (0.75–0.83), and of hind leg 0.86 (0.83–0.92). Halteres white. Wings with coloration as in male, relatively broader than in male. Abdomen entirely yellowish white or pale brown, with cerci (Plate 4, fig. 78) discoidal, spermathecæ (fig. 79) dark brown, broadly hyaline on basal one-third, spherical.

In darker specimens, which are often males, the thorax, including the scutellum, is dark brown or black; scutal vittæ indistinct in alcoholic specimens, pruinose areas along foveæ disappearing; abdomen mainly dark brown or black, several anterior terga paler along caudal margin; legs with broad black rings.

Specimens.—Alcoholic males and females; Kyoto: Shimogamo, September 6, 1929, May 19 and July 4, 1930; Hachijo, May 20 and 30 and September 6, 1930, July 6, 1931, and July 5, 1934; Arashiyama, October 2, 1930; Kibune, July 2, 1932, September 16, 1933, October 16, 1934; Yamashina, August 1, 1932; Uzumasa, July 9, 1934; Kitashirakawa, October 31, 1935; Seto, Wakayama Prefecture, June 26, 1930; Mount Daisen, Tottori Prefecture, July 2, 1931; Karo, Tottori Prefecture, July 3 to 5, 1931; Iyayama, Tokushima Prefecture, August 3, 1934; deposited

in the entomological laboratory, Kyoto Imperial University; collected by Messrs. Y. Yoshimura, M. Morishita, and M. Tokunaga.

Pentaneura semiglaber Kieffer is said to be provided with styles of the male hypopygium of which the distal half is bare; in Japanese specimens of *P. monilis,* however, some individuals show structures quite similar to those of *semiglaber,* besides close similarity of coloration, and some other individuals exhibit transitional characters from the former species. From these observations on 118 specimens, I am led to treat *P. semiglaber* Kieffer as a synonym of *P. monilis* Linnæus.

PENTANEURA OCTOPUNCTATA sp. nov.

The specimens of this whitish species were captured at light in Kyoto.

Male.—Body length 3.8 to 4 mm, yellowish white in ground color, with eight black spots on orange-yellow scutal vittæ.

Head uniformly yellow or whitish. Antennæ pale brown, with scapes yellow, plumose hairs yellow, 14-segmented, with a short apical seta; antennal ratio about 1.66. Thorax yellowish white or pure white in ground color; scutum with four orange-yellow or pure yellow vittæ and four pairs of black spots; one pair on anterior end of median vittæ, one pair on middle of median vittæ, one on anterior end of each lateral vitta, and one just caudad of each lateral vitta; postscutellum with a pair of pale brown or black spots in whitish ground color; each pleural side with two black spots or clouds: one just caudad of mesospiracle and the other larger one along dorsal side of episternal suture; sternal side yellow. Legs pale brownish white; knee joints distinctly black; empodium short; claws simple; pulvilli vestigial; relative length of segments 60 : 76 : 60 : 29 : 21 : 15 : 8 in foreleg, 68 : 65 : 39 : 19 : 13 : 10 : 6 in middle leg, and 60 : 83 : 64 : 29 : 21 : 13 : 7 in hind leg. Halteres white. Wings (Plate 3, fig. 42) with four black spots: one covering arculus and humeral crossvein; one covering base of radial branches, first section of M_{3+4}, and r-m; one covering end of R_1 and fork of R_{2+3}; and one covering end of R_{4+5}; squama with a dark spot. Abdomen yellow or pure white; first tergum sometimes with a pair of pale brown clouds; second without markings; terga from third to fifth each with a very narrow brownish band along cephalic margin; sixth tergum with a pair of small pale brown clouds along cephalic margin; seventh entirely brown or pale brown; eighth also entirely pale brown or white; ninth white,

with a pair of small caudal setigerous tubercles; hypopygium (Plate 5, fig. 91) brown; coxite broad, with a basal lobe; style stout setigerous.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Hachijo, Kyoto; May 22, 1930.

Paratopotype.—Alcoholic male; Kitashirakawa, Kyoto; August 1, 1934.

Type specimens.—Deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is closely allied to *Pentaneura tripunctata* Goetghebuer, in which, however, the scutal markings are different, the male antennal ratio is about 1.33, and the style of the hypopygium is provided with only two preapical setæ.

PENTANEURA MONTICOLA sp. nov.

The only specimen of this fly was captured beside a stream.

Male.—Body length about 2.5 mm, ground color yellowish white; thorax with brown markings on orange-yellow scutal vittæ; abdomen yellowish white, with posterior two terga entirely brown; wings with two large pale brown clouds.

Head whitish yellow. Maxillary palpi pale brown. Antennæ brown, with plumose hairs brown, scapes yellow and pale brown on distal parts, 14-segmented; antennal ratio about 1.9. Thorax whitish yellow; scutum with four brown markings on orange-yellow vittæ: one pair of small spots on caudal part of median vittæ and one pair of long stripes along mesal margin of lateral vittæ; scutellum whitish; postscutellum brown; pleural membrane extensively whitish yellow; pleural and sternal sclerites mainly brown, yellow on a triangular area along ventral side of episternal suture. Legs with fore coxæ brown, middle and hind coxæ whitish; other segments all white. Halteres white. Wing (Plate 4, fig. 65) with veins white, two large pale brown clouds: one on distal part of wing and one beyond the middle of wing. Abdomen whitish yellow, somewhat brown due to hypocutaneous pigment; seventh and eighth terga brownish; hypopygium (Plate 4, fig. 77) whitish, with slender styles and coxites; style pubescent on basal half or more but without distinct setæ, not pubescent on distal half but with distinct setæ, with a strong apical spine.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Ashiu, Kyoto; May 10, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles *Pentaneura maculipennis* Zetterstedt in the coloration of thorax and abdomen, but is distinctly different in wing markings and hypopygial structures.

PENTANEURA FUSCICLAVA Kieffer.

Tanypus fusciclava KIEFFER, Ann. Soc. Linn. Lyon 69 (1922) 40–41.

This species is found at Daitotei, Formosa.

Female.—Body about 1.2 mm in length, reddish brown in ground color, wing with a transversal band. Antennæ whitish, 12-segmented; ultimate segment brown, about twice as long as penultimate, with basal verticils. Scutum yellowish on anterior half, darker on posterior half, with brownish vittæ. Legs pale yellow; tibia of foreleg longer than first tarsal segment; pulvilli absent. Halteres with knobs dark brown, stems paler. Wings slightly brownish, with a brown band which covers apical part of Cu_1 and is enlarged caudad; costa not produced beyond end of R_{4+5}.

PENTANEURA MACULIPENNIS Zetterstedt.

Pentaneura subincurvatus GOETGHEBUER and *P. costalis* KIEFFER are synonyms and *P. laetus* MEIGEN and *P. muscicola* KIEFFER are probably synonyms.

This fly is common at Kyoto.

Male.—Body about 4 mm; ground color whitish yellow or white; head with a subtriangular black marking on vertex; scutum with four orange-yellow vittæ, with dark markings on these vittæ and along cephalic margin of scutum; wings with two dark bands; femur with black preapical ring.

Head whitish, with eyes and scapes black, frontoclypeus black or brownish; vertex with a subtriangular black marking on meson. Antennæ with flagellar segments whitish, plumose hairs bicolored: yellow on proximal hairs, black on distal hairs, 14-segmented; antennal ratio about 1.8. Thorax with ground color whitish yellow; scutum with four orange-yellow vittæ and dark markings: one pair of small markings on middle of median vittæ, one pair of long markings along lateral side of lateral vittæ, one pair of black spots just caudad of lateral vittæ, dark or dark brown marking along midcephalic margin of scutum; scutellum white, postscutellum black or dark brown; pleural and sternal sclerites black; pleural membranes extensively yellow; each pleural side with a triangular yellow marking above episternal suture. Legs, including coxæ, yellow; femur with a broad black preapical ring; distal three tarsal segments of foreleg somewhat darker; proportional lengths of segments

71 : 72 : 39 : 20 : 16 : 14 : 8 in foreleg, 69 : 85 : 70 : 38 : 26 : 19 : 10 in middle leg, and 66 : 94 : 70 : 40 : 30 : 20 : 10 in hind leg. Halteres white. Wing (Plate 3, fig. 41) with two dark bands: proximal one covering transversal veins, and distal one arising between ends of R_1 and R_3 and divergent caudad ending ends of Cu_1 and M_{3+4}; often a small brownish apical cloud. Abdomen mainly whitish yellow; first tergum unmarked; terga from second to sixth each with a narrow dark brown band along cephalic margin, some of these bands sometimes interrupted at middle; seventh and eighth broadly or entirely dark brown; ultimate segment whitish; hypopygium (Plate 5, fig. 88) whitish; styles sicklelike, angulated at middle.

Female.—Body 2.5 to 3 mm long, color as in male. Antennæ 12-segmented; scape whitish; ultimate segment pale brown, with several basal setæ, subequal to preceding three segments together (57: 58–59); antennal ratio about 0.3. Relative lengths of segments of legs as follows: 60: 76: 61: 31: 22: 15: 9 in foreleg, 65 : 68 : 40 : 20 : 15 : 12 : 7 in middle leg, and 58 : 85 : 58 : 33 : 26: 16: 9 in hind leg. First and second abdominal terga, each with a pair of small brown lateral clouds on anterior half; third to sixth terga, each with three small brown clouds on anterior half; on seventh and eighth terga those clouds somewhat confluent; ultimate tergum whitish; cerci (Plate 4, fig. 58) white, subtriangular; spermathecæ (fig. 57) short, oval, brown, with broad hyaline basal portion.

Specimens.—Alcoholic males and females; Kyoto: Shimogamo, March 7 and May 18, 1930; Hachijo, September 29, 1930 and May 16, 1932; Arashiyama, October 2, 1930; Kibune, March 5, 1931; Kitashirakawa, September 30, 1934 and November 31, 1935; Yamashina, October 18, 1935; Nishigamo, December 15, 1935; and Mount Ryozen, Mie Prefecture, June 3, 1930; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. T. Kani and M. Tokunaga.

The male Japanese specimens differ from the descriptions based on European specimens in having the wing markings more extensive, antennal ratio less than 2, and the abdominal bands more complete.

PENTANEURA ALBA sp. nov.

Male.—Body length 2.3 to 2.7 mm, entirely yellowish white. Head with eyes bicolored, dorsal half, pale brown and ventral half, dark brown. Antennæ entirely yellowish white. Thorax white; scutellum without vittæ or with yellow lateral vittæ.

Legs entirely white; tibiæ of middle leg longer than first tarsal segment (68 : 40). Wings without colored markings; costa slightly produced beyond end of R_{4+5}; R_{2+3} atrophied on distal portion; R_{4+5} twice as long as R_1. Abdomen entirely yellowish white; hypopygium (Plate 4, fig. 74) slender; with straight styles.

Female.—Body length 2 to 2.5 mm. Antennæ 12-segmented; ultimate segment with a few (3 or 4) basal setæ, subequal in length to preceding three segments together (56.7: 55.3); antennal ratio 0.3 (0.28–0.33). Tibia of middle leg longer than first tarsal segment (63.7: 36.3). Wings (Plate 4, fig. 64) with costa slightly produced, R_{2+3} complete and fored or atrophied before end. Cerci (fig. 76) produced ventrad; spermathecæ (fig. 75) yellow, oval.

Habitat.—Honshu, Japan.

Holotype.—Male; Mount Atago, Kyoto; May 31, 1931.

Allotype.—Female; Kurama, Kyoto; October 23, 1932.

Paratypes.—Male and females; Kyoto: Mount Atago, May 31, 1931; Kurama, October 23, 1932; Kibune, October 16, 1934; and Iyayama, Tokushima Prefecture; August 3, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. M. Morishita and M. Tokunaga.

This fly is somewhat similar to *Pentaneura binotata* Wiedemann and *P. melanops* Meigen, but in *binotata* the bases of the sixth and seventh abdominal terga are somewhat dark and in *melanops* the seventh abdominal tergum is darker; the styles of the male hypopygium are also distinct in each species.

PENTANEURA JAPONICA sp. nov.

Female.—Body about 2.5 to 3 mm long, entirely white, with eight black spots on scutum. Antennæ 12-segmented, white; ultimate segment yellowish, subequal to preceding four segments together (59 : 61), without basal setæ; antennal ratio about 0.32. Thorax white; scutum sometimes with four pale yellow vittæ; dark spots: two pairs on cephalic and caudal ends of median vittæ, one pair on cephalic end of lateral vittæ, and one pair just caudad of lateral vittæ. Halteres, legs, and abdomen entirely white. Proportional lengths of segments of legs 53 : 72 : 56 : 30 : 21 : 16 : 9 in foreleg, 60 : 68 : 38 : 19 : 15 : 12 : 6.5 in middle leg, and 53 : 79 : 57 : 32 : 25 : 16 : 9 in hind leg. Wings (Plate 4, fig. 63) without markings. Cerci (Plate 4, fig. 72)

somewhat rectangular; spermathecæ (fig. 73) spherical, pale yellow.

Habitat.—Honshu, Japan.

Holotype.—Female; Arashiyama, Kyoto; October 2, 1930.

Paratype.—Female; Kitashirakawa, Kyoto; August 15, 1928.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly is closely allied to *Pentaneura melanops* Meigen, but differs in color and antennal structures: in *melanops* the thorax has four black spots and the antennæ antennal ratio is less than 0.3; the ultimate segment is shorter than the preceding three segments together.

PENTANEURA MELANOPS Meigen.

Pentaneura bicolor FRIES and *P. interseptus* WALKER are synonyms.

This species is common in Japan.

Male.—Body 4 to 4.5 mm in length, yellowish white; thorax with four black spots. Antennæ with scapes yellow, flagellum and plumose hairs pale brownish yellow, 14-segmented; antennal ratio about 1.9. Thorax yellowish white; scutum with four black spots arranged transversally, sometimes with four yellow vittæ; postscutellum sometimes pale brown. Legs entirely yellowish white; proportional lengths of segments 67 : 83 : 68 : 35 : 25 : 18 : 9 in foreleg, 70 : 68 : 42 : 20 : 15 : 13 : 7 in middle leg, and 65 : 94 : 66 : 35 : 27 : 18 : 9 in hind leg. Wings (Plate 4, fig. 62) without markings. Abdomen yellowish white, terga with faint pale brown clouds along cephalic margins; these clouds in some specimens forming bands; seventh tergum broadly clouded; hypopygium (Plate 5, fig. 89) brown; coxite with a basal setigerous lobe; style distinctly angulated beyond middle, sicklelike.

Female.—Body length 2.2 to 4 mm. Antennæ 12-segmented; ultimate segment with several basal setæ, shorter than preceding three segments together (62 : 73); antennal ratio about 0.25. Tibia of middle leg far longer than first tarsal segment (90 : 52). Abdomen entirely white; cerci (Plate 4, fig. 69) somewhat triangular; spermathecæ (fig. 68) oval, hyaline. In some specimens scutum with four yellow vittæ and postscutellum yellow.

Specimens.—Alcoholic males and females; Kyoto: Kitashirakawa, August 15, 1928; Shimogamo, May 18, 1930; Hachijo, May 22, 1930; Nishigamo, April 10, 1932; Uzumasa, October 11,

1932; Kurama, October 23, 1932; Kibune, October 16 and November 3, 1934; and Gotemba, Shizuoka Prefecture, May 24, 1932; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. N. Omori and M. Tokunaga.

PENTANEURA LONGIPENNIS sp. nov.

Male.—Body length about 4.2 mm, yellowish brown in ground color, with four brown distinct scutal vittæ.

Head with vertex brown, other parts, including mouth parts, yellowish brown. Antennæ 14-segmented, uniformly pale brown, with antennal ratio about 1.7. Thorax yellow in ground color; scutum with four brown vittæ; postscutellum brown; pleural sclerites yellowish. Legs uniformly pale brown; relative lengths of segments of legs 70 : 82 : 61 : 40 : 28 : 17 : 10 in foreleg, 77 : 82 : 41 : 32 : 22 : 13 : 9 in middle leg and 68 : 98 : 64 : 44 : 31 : 17 : 10 in hind leg. Halteres white. Wings (Plate 4, fig. 60) with R_{2+3} atrophied distad. Abdomen yellow; terga from second to six each with a brown band on anterior half, seventh and eighth uniformly brown; hypopygium (Plate 5, fig. 85) yellowish, slightly brown on lateral sides of coxites; styles small, slender, straight.

Female.—Body 2.5 to 3.5 mm, coloration generally as in male. Antennæ 12-segmented; ultimate segment with four long basal setæ, shorter than preceding three segments together (62.5 : 68.5); antennal ratio 0.27 to 0.29. R_{2+3} forked, but atrophied beyond this point; costa more produced than in male. First abdominal tergum somewhat clouded; cerci (Plate 4, fig. 70) yellow; spermathecæ (fig. 71) spherical, brown, with hyaline basal portion.

Habitat.—Honshu, Japan.

Holotype.—Male; Kibune, Kyoto; August 13, 1931.

Allotype.—Female; Kurama, Kyoto; October 23, 1932.

Paratype.—Female; Kurama, Kyoto; October 23, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

The present species resembles *Pentaneura nigropunctata* Staeger and *P. signatipennis* Kieffer. In the former allied species antennal ratio of the male is less than 1.5, but a little larger than 1, and in the latter species the costa is not produced beyond the end of R_{4+5}, and the tibial spurs are comparatively large and different in structure.

PENTANEURA DIVISA Walker.

This species was collected at the base of Mount Fuji in spring.

Male.—Body 2.5 to 3.5 mm in length, yellowish white, with lateral vittæ, but without median vittæ on scutum. Head yellow or yellowish brown. Antennæ yellowish brown, 14-segmented; antennal ratio 1.6. Thorax yellowish white; scutum with brown lateral vittæ and small pale brown clouds on cephalic half and caudal part; postscutellum brown. Legs pale brown; proportional lengths of segments of middle leg 63 : 60 : 49 : 26 : 16 : 11 : 7. Halteres white. Wings (Plate 4, fig. 59) with costa slightly produced, R_{2+3} atrophied at distal part, its fork obscure. Abdomen yellowish white, first tergum with a pair of faint pale brown clouds; second without markings; third and fourth each with a broad brown cephalic band; fifth with a faint pale brown median cloud; the following three broadly or entirely brown; hypopygium (Plate 5, fig. 86) slender, brown, with styles very long and pubescent at base.

Specimens.—Alcoholic males; Gotemba, Shizuoka Prefecture; May 24, 1932; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. N. Omori.

The Japanese specimens seem to be somewhat paler than the European specimens, especially in the color of the thoracic region. In a small male specimen from the same locality, the pale brown clouds of the first and fifth terga disappear, being entirely yellow, and the penultimate segment of the antenna is abnormally short, the antennal ratio being only 0.83.

PENTANEURA KYOTOENSIS sp. nov.

Male.—Body about 3 mm long, ground color yellow; thorax with scutal vittæ; abdomen with many pale brown bands; wings unmarked.

Head yellow, with vertex pale brownish yellow. Antennæ 15-segmented, with scapes brownish yellow, flagellar segments pale brown, with a short apical seta on terminal stylet; antennal ratio about 1.4. Thoracic ground color yellow; pronotum pale brownish yellow; scutum yellow, with two brownish yellow median and two brown lateral vittæ, cephalic margin brown; scutellum yellow; postscutellum pale yellowish brown; pleural and sternal sides extensively yellow; cephalic sclerites of notepisternum and epimeron brown. Legs entirely yellow; tibial spurs of middle leg distinctly unequal: larger one more than four times as long as the other, which is only vestigial. Hal-

teres yellow. Wings (Plate 4, fig. 61) with R_{2+3} atrophied beyond its fork; costa not produced. Abdomen yellow, with pale brown bands on terga; first tergum with a caudal band; second to fourth each with a broad band on cephalic half; fifth with a narrow cephalic band; sixth almost entirely pale brown; seventh with a subtriangular cloud on cephalic half; eighth entirely pale brown; ninth yellow; hypopygium (Plate 5, fig. 87) yellow, slender; styles straight, about two-thirds as long as coxites, pubescent on basal half.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic male; Uzumasa, Kyoto; October 11, 1934; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. Y. Yoshimura.

This is closely allied to *Pentaneura divisa* Walker, but different in the coloration of the abdominal terga, the relatively short styles of the male hypopygium, and the proportional length of the tibial spurs of the middle leg.

PENTANEURA MULTIFASCIA sp. nov.

This fly is common at Kyoto in spring near still water.

Male.—Body 4 to 5 mm long, yellow in ground color; thorax with three distinct vittæ; wing without markings; abdominal terga with dark brown bands.

Head, including mouth parts, brown. Antennæ with scapes reddish brown, flagellar segments brown, plumose hairs brown, 15-segmented; antennal ratio about 2.1. Thoracic ground color yellow; pronotum pale brown; scutum yellow, with a median vitta reddish brown on cephalic half and dark brown on caudal half, two lateral vittæ dark brown; scutellum yellow; postscutellum black; pleural and sternal sclerites reddish brown, with membranes yellow. Legs entirely pale brown, with beards on fore tarsi; proportional lengths of segments of fore and hind legs 80 : 98 : 77 : 39 : 29 : 20 : 11 and 77 : 105 : 71 : 41 : 31 : 20: 11, respectively. Halteres yellow. Wings (Plate 3, fig. 43) with costa slightly produced beyond end of R_{4+5}. Abdominal segments yellow in ground color; terga with a dark brown band on each cephalic region; first without band; from second to sixth each with a band; seventh dark brown on cephalic half and brown on caudal half; following two terga entirely brown; ninth tergum with a pair of minute setigerous tubercles; hypopygium (Plate 5, fig. 90) dark brown; coxites broad; styles curved, sicklelike, almost entirely pubescent, with a terminal seta and strong spine.

Habitat.—Honshu, Japan.

Holotype.—Male; Nagaoka, Kyoto; April 5, 1936.

Paratypes.—Males; Kyoto; Kitashirakawa, March 31, 1932; Nishigako, April 10, 1932; Nagaoka, April 5, 1936.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles *Pentaneura melanura* Meigen, *P. setiger* Kieffer, and *P. falciger* Kieffer, but these allied species are all provided with slenderer and less-curved styles of the hypopygium.

PENTANEURA GRACILLIMA (Kieffer).

Pelopia gracillima KIEFFER, Ann. Mus. Nat. Hung. 14 (1916) 102.

This fly was collected at Takao, Formosa, by Sauter.

Male.—Body about 2.5 mm in length, whitish in ground color. Head reddish brown. Antennæ brownish white, with scapes reddish brown; 14-segmented; penultimate segment twice as long as preceding eleven segments together; plumose hairs gray. Scutum with three reddish vittæ, which are more or less confluent; postscutellum and pleural and sternal sclerites reddish. Legs whitish, without clouds; fore tibia one and one-half times as long as first tarsal segment; hind tibia slightly longer than first tarsal segment. Halteres white. Wings hyaline; costa produced beyond tip of R_{4+5}; r-m at fork of M; m-cu very short, almost absent. Abdomen whitish; cephalic three terga each with a dark brown band; fourth without markings; caudal three terga entirely dark brown; hypopygium white; styles slender, long reaching bases of coxites, bare, gradually curved.

DIAMESINÆ

After the publication of my previous paper (1936) which included about sixteen species, I found several species of this subfamily from Honshu, including the curious genus *Heptagyia* Philippi.

DIAMESA (DIAMESA) PLUMICORNIS Tokunaga.

Since the publication of the description of the male of this fly in my previous report, part VI of the chironomid series, I have collected one specimen of each sex at Kibune, Kyoto.

Female.—Body about 4.8 mm in length, black in ground color, thorax highly pruinose in white along pseudosutural foveæ, pronotum setigerous at side.

Head entirely black; antennæ 8-segmented (20 : 37 : 23 : 23 : 19 : 19 : 18 : 63), ultimate segment longer than preceding three together (63 : 58), with two apical and two basal setæ; antennal ratio about 0.48. Thorax with black scutal vittæ separated by pruinose lines (in alcoholic specimen entirely black); scutum setigerous along foveæ, its setæ arising from distinct punctures of integument. Legs entirely black, with tarsal spurs on ventral sides and tips of proximal two segments of all legs; claws simple; empodium elongate; fourth tarsal segment obcordate; proportional lengths of segments of foreleg 82 : 98 : 67 : 32 : 19 : 8 : 9, those of middle leg 90 : 90 : 40 : 21 : 14 : 7 : 7.5, those of hind leg 99 : 103 : 63 : 36 : 19 : 7 : 8. Halteres white. Wings (Plate 5, fig. 84) dark brown under transmitted light, especially darker on apical and marginal areas, with veins dark, with distinct microtrichia, without macrotrichia on membrane; alula fringed with several delicate hairs; vein R_1 closely applied along costa at its swollen distal area, costa slightly produced beyond end of R_{4+5}, crossvein r-m gradually curved. Abdomen entirely dark brown, with cerci slightly produced ventrad (Plate 5, fig. 94), spermathecæ dark brown, ovoid (fig. 95).

Allotype.—Alcoholic female; Kibune, Kyoto; March 25, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

The male specimen collected at the same locality has the antennal ratio 1.3.

SYNDIAMESA (SYNDIAMESA) BICOLOR sp. nov.

This fly was also collected at Kibune, Kyoto, in early spring.

Female.—Body 4 to 4.9 mm long, ground color yellowish brown, scutellum with three distinct dark vittæ, wings bicolored the proximal one-third yellowish and distal two-thirds brownish.

Head yellowish brown, with region of vertex dark brown, frontoclypeus brown, area between compound eyes yellow, mouth parts brown, eyes bare. Antennæ 7-segmented (25 : 30 : 18 : 23: 20: 25: 68); proximal three segments including scape yellow, distal segments brown; ultimate segment with two apical setæ, without basal setæ; intermediate flagellar segments each with several verticils and four short trichoid sensillæ; antennal ratio about 0.6. Maxillary palpi 5-segmented (4: 6: 13: 17: 22), brown; third segment produced beyond insertion of fourth segment, black at tip. Pronotum yellow at dorsal part, yellowish brown at lateral parts, with three or four setæ at each side; scutum yellowish brown, highly pruinose and setigerous along

foveæ, with four vittæ, of which lateral are black and median brown on cephalic half and dark brown on caudal half; scutal setæ arise from small pale punctures of integument; scutellum brown; postscutellum black, not distinctly elongate caudad, round at caudal margin; pleural membranes yellow, pleural sclerites mainly yellowish brown; caudal half of notepisternum brown; sternepisternum and sternum brown or dark brown. Forelegs mainly dark brown, with trochanters and femoral bases brown; middle and hind legs with coxæ dark brown, trochanters and femora yellowish brown, knee joints black, tibiæ bicolored, being yellow on proximal three-fourths and black on distal one-fourth, tarsi entirely dark brown; fourth tarsal segments cylindrical; relative lengths of leg segments 92 : 107 : 83 : 40 : 28 : 13 : 11 in foreleg, 94 : 104 : 50 : 26 : 19 : 10 : 11 in middle leg, and 105 : 119 : 69 : 38 : 24 : 12 : 12 in hind leg; tarsal spurs on ventral sides and tips of proximal two segments of middle and hind legs; forelegs without tarsal spurs; claws simple; empodium small. Halteres yellow. Wings (Plate 5, fig. 83) bicolored, mainly brown, yellow basally under transmitted light, with distinct microtrichia but without macrotrichia on membrane; veins brown; costa slightly produced; r-m almost straight; alula fringed with delicate hairs. Abdominal terga all brown, sterna and cerci pale brown; cerci as in Plate 5, fig. 96; spermathecæ elongate, brown, each with a swollen hyaline neck region (fig. 97).

Habitat.—Honshu, Japan.

Holotype.—Female; Kibune, Kyoto; March 2, 1933.

Paratopotypes.—Females; March 2, 1933.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly resembles *Syndiamesa* (*Syndiamesa*) *takatensis* Tokunaga, especially in the structure of maxillary palpi, but differs in coloration, especially in the bicolored wings.

SYNDIAMESA (LASIODIAMESA) CRASSIPILOSA sp. nov.

Female.—Body mainly black, 4.6 to 5.5 mm in length, wings with many macrotrichia on membrane.

Head with vertex dark brown, frontoclypeus, mouth parts and antennæ brown; eyes minutely pubescent, hairs being shorter than height of corneal lenses; antennæ 7-segmented (22 : 40 : 20 : 24 : 20 : 21 : 56); antennal ratio 0.45; second segment yellowish on basal half; ultimate segment with two apical and one

basal seta; maxillary palpi 5-segmented (3 : 7 : 12 : 17 : 21). Pronotum setigerous, dark brown; scutum black, with many erect setæ which arise from pale punctures, pruinose; scutellum and postscutellum black; pleuron with membranes yellow, sclerites black. Legs entirely dark brown; claws simple; empodium large; proportional lengths of segment of legs as follows: 95 : 114 : 78 : 41 : 26 : 13 : 11 in foreleg, 98 : 101 : 45 : 28 : 19 : 9.5 : 10.5 in middle leg, and 108 : 128 : 68 : 37 : 23 : 11 : 11 in hind leg; forelegs without tarsal spurs; middle and hind legs with tarsal spurs on proximal two segments. Halteres yellow. Wings (Plate 4, fig. 67) brown, faintly yellow at base; veins brown, setigerous; r-m almost straight, oblique; costa produced beyond end of R_{4+5}; membrane highly setigerous with short macrotrichia; cell R_5 bare on cephalic longitudinal half. Abdominal terga brown; sterna somewhat paler; cerci brown, highly produced ventrocephalad (Plate 5, fig. 92); spermathecæ dark brown, elongate, each with a pale brown basal part (fig. 93).

Habitat.—Honshu, Japan.

Holotype.—Female; Kibune, Kyoto; March 2, 1933.

Paratopotype.—Female; March 2, 1933.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly is closely related to *Syndiamesa* (*Lasiodiamesa*) *pilosa* Kieffer, in which, however, the macrotrichia of the wings are found only on the distal areas of cells R_5 and M_2.

HEPTAGYIA NIPPONICA sp. nov.

This fly was collected at ligth in the autumn at Kibune, Kyoto.

Female.—General appearance somewhat like that of *Cricotops;* body 3.5 mm in length, yellowish white in ground color; thorax with distinct vittæ.

Head with vertex dark brown; frontoclypeus and mouth parts pale brownish yellow; eyes bare, widely separated on dorsal side, distance between them greater than vertical length of eyes. Antennæ yellowish, 7-segmented (24 : 22 : 13 : 16 : 15 : 17 : 69); ultimate segment subequal in length to preceding four together, with pointed tip, a small apical seta, without basal setæ; second segment slightly constricted before middle; intermediate flagellar segments each with four verticils and three trichoid sensillæ; antennal ratio about 0.8. Maxillary palpi 5-segmented, longer than antennæ; ultimate segment longer than penultimate but

shorter than preceding two together. Pronotum yellowish white, with several yellow setæ at side; scutum shining, with three dark brown vittæ on yellow ground, with several yellow setæ along each fovea; scutellum brown, dark brown at margin, setigerous; postscutellum black; pleuron yellowish white in ground color; posterior half of notepisternum brown; epimeral sclerites pale brown; sternepisternum yellow, with ventral side brown, with a pair of brown stripes along lateral margin of ventral brown area. Legs with distinct tibial rings; foreleg with coxa and trochanter pale brown; femur dark brown, with basal one-fourth pale brown; tibia dark brown, with a narrow pale ring before middle; tarsus entirely dark brown; middle and hind legs similar in color to each other, with coxæ and trochanters yellowish white, tarsi dark brown; femora yellowish white, distal one-fourth dark brown; tibiæ dark brown, widely yellowish white at middle one-third; claws simple, with a strong and two small basal setæ; empodium small; pulvilli absent; fourth tarsal segment obcordate; tarsal spurs on proximal two segments of middle and hind legs, absent on forelegs; proportional lengths of leg segments as follows: 62 : 72 : 63 : 28 : 16 : 4 : 6.8 in foreleg, 65 : 67 : 35 : 19 : 10 : 4 : 6 in middle leg, and 71 : 81 : 49 : 24 : 11.5 : 4.5 : 7 in hind leg. Wings (Plate 5, fig. 82) about 2.8 mm in length, without both macro- and microtrichia on membrane; both squama and alula fringed; main veins yellow; R and R_1 setigerous with yellow setæ; R_{4+5} slightly setigerous at tip; costa distinctly produced beyond tip of R_{4+5}; R_{2+3} and M complete, not partially atrophied. Halteres white. Abdomen yellowish; tergum of second segment with a median pale brown cloud, terga from third to eighth each with a brown-clouded band; cerci white.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic female; Kibune, Kyoto; October 23, 1932; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

Females of two European species, *Heptagyia cinctipes* Edwards and *H. rugosa* Saunders, have the thorax dull black or black. In *H. lurida* Garrett, according to the description of Johannsen, the base of vein M is almost invisible, the ultimate segment of the maxillary palpus is as long as the preceding two segments taken together, and the last antennal segment is twice as long as the penultimate and has two apical setæ.

HEPTAGYIA EBURNEA sp. nov.

Female.—Body length only 2 mm, ivory white in ground color. Head with vertex pale brown, mouth parts, frontoclypeus, and antennæ yellow or yellowish white. Antennæ 7-segmented (15 : 14 : 9 : 10 : 13 : 13 : 44), second and third segments incompletely segmented; ultimate segment elongate fusiform, with a small apical seta, without basal setæ, subequal in length to preceding four segments together. Pronotum yellow; scutum shining, pale yellowish white, with three brown vittæ, setigerous with several small decumbent setæ along each fovea; scutellum brownish yellow; postscutellum brown; pleural side yellow, with a brown cloud ventrad of wing base; sternal side pale brownish yellow. Foreleg mainly dark brown, with coxa, trochanter, and basal one-fifth of femur yellow; middle and hind legs similar in color to each other, with coxæ yellow, trochanters and femora yellowish white, knee joints very narrowly dark; tibiæ white, with distal end dark; first tarsal segment yellow, with end dark; remaining tarsal segments all dark brown; claws simple; pulvilli wanting; empodium very small; proximal two tarsal segments of middle and hind legs with paired apical spurs; forelegs without tarsal spurs; fourth tarsal segments of all legs distinctly cordiform; proportional lengths of segments of legs 36 : 40 : 35 : 16 : 10 : 3 : 4.5 in foreleg, 37 : 37 : 21 : 11 : 7 : 3 : 4.3 in middle leg, and 39 : 43 : 29 : 15 : 8 : 3 : 4.8 in hind leg. Halteres white. Wings (Plate 5, fig. 81) clearly hyaline, without both macro- and microtrichia; vein R and R_1 setigerous; R_{4+5} distally setigerous; M complete; R_{2+3} distally atrophied. Abdominal terga brownish yellow, paler on basal segments; sterna and cerci yellow.

Habitat.—Honshu, Japan.

Holotype.—Alcoholic female; Mount Ryozen, Siga Prefecture; June 3, 1930; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species may be allied to *Heptagyia alboannulata* Strobl, but differs in having the first tarsal segments of the middle and hind legs yellow.

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[Mainly on the Japanese Tanypodinæ.]

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ILLUSTRATIONS

PLATE 1. ANATOPYNIA VARIA FABRICIUS

FIG. 1. Salivia and associated structures of larva, dorsal aspect.
2. Clypeolabrum of larva, cephalic aspect.
3. Antenna of larva.
4. Mandible of larva, with two tendons.
5. Hypopharyngeal sclerites of larva, with three tendons, dorsal aspect.
6. Labium of larva, ventral aspect.
7. Fifth abdominal tergum of larva.
8. Full-grown larva.
9. Claws of posterior pseudopod of larva.
10. Fifth abdominal segment of pupa; left half, dorsal side; right half, ventral side.
11. Seventh abdominal segment of pupa; left half, dorsal side; right half, ventral side.
12. First abdominal segment of pupa, dorsal aspect.
13. Prothoracic respiratory organs; left figure, dorsal aspect; right figure, lateral aspect.
14. Caudal swimming paddle of pupa, dorsal aspect.
15. Swimming paddle of pupa, pointed end.

PLATE 2

FIG. 16. *Clinotanypus decempunctatus* sp. nov., female wing.
17. *Clinotanypus japonicus* sp. nov., male wing; *av*, anastomosed vein of M_{3+4} and Cu_1; *fMCu*, fork between M_{3+4} and Cu_1; *fs*, first section of M_{3+4}.
18. *Clinotanypus sugiyamai* sp. nov., male wing.
19. *Tanypus punctipennis* Fabricius, male wing.
20. *Procladius sagittalis* Kieffer, female wing.
21. *Procladius nipponicus* sp. nov., male wing.
22. *Procladius crassinervis* Zetterstedt, female wing.
23. *Anatopynia nebulosa* Meigen, female wing.
24. *Clinotanypus japonicus* sp. nov., male hypopygium.
25. *Clinotanypus sugiyamai* sp. nov., male hypopygium.
26. *Tanypus punctipennis* Fabricius, female cercus.
27. *Tanypus punctipennis* Fabricius, female spermatheca.
28. *Tanypus punctipennis* Fabricius, male hypopygium.
29. *Procladius sagittalis* Kieffer, male hypopygium.
30. *Procladius sagittalis* Kieffer, female cercus.
31. *Procladius sagittalis* Kieffer, male spermatheca.
32. *Procladius nipponicus* sp. nov., male hypopygium.
33. *Procladius nipponicus* sp. nov., female cercus.

PLATE 3

FIG. 34. *Procladius nipponicus* sp. nov., female spermathecæ.
35. *Anatopynia kibunensis* sp. nov., female wing.
36. *Anatopynia japonica* sp. nov., female wing.
37. *Anatopynia goetghebueri* Kieffer, male wing.
38. *Anatopynia varia* Fabricius, male wing.
39. *Anatopynia yoshimurai* sp. nov., female wing.
40. *Pentaneura minuta* sp. nov., male wing.
41. *Pentaneura maculipennis* Zetterstedt, male wing.
42. *Pentaneura octopunctata* sp. nov., male wing.
43. *Pentaneura multifascia* sp. nov., male wing.
44. *Procladius crassinervis* Zetterstedt, female cercus.
45. *Procladius crassinervis* Zetterstedt, female spermatheca.
46. *Anatopynia nebulosa* Meigen, female spermatheca.
47. *Anatopynia nebulosa* Meigen, female cercus.
48. *Anatopynia goetghebueri* Kieffer, male hypopygium.
49. *Anatopynia goetghebueri* Kieffer, female spermatheca.
50. *Anatopynia goetghebueri* Kieffer, female cercus.
51. *Anatopynia varia* Fabricius, female cercus.
52. *Anatopynia varia* Fabricius, female spermatheca.
53. *Anatopynia japonica* sp. nov., male hypopygium.
54. *Anatopynia yoshimurai* sp. nov., female cercus.
55. *Anatopynia yoshimurai* sp. nov., female spermatheca.
56. *Anatopynia varia* Fabricius, male hypopygium.
57. *Pentaneura maculipennis* Zetterstedt, female spermatheca.
58. *Pentaneura maculipennis* Zetterstedt, female cercus.

PLATE 4

FIG. 59. *Pentaneura divisa* Walker, male wing.
60. *Pentaneura longipennis* sp. nov., male wing.
61. *Pentaneura kyotoensis* sp. nov., male wing.
62. *Pentaneura melanops* Meigen, male wing.
63. *Pentaneura japonica* sp. nov., female wing; *fs*, first section of M_{3+4}.
64. *Pentaneura alba* sp. nov., female wing.
65. *Pentaneura monticola* sp. nov., male wing.
66. *Pentaneura monilis* Linnæus, male wing.
67. *Syndiamesa* (*Lasiodiamesa*) *crassipilosa* sp. nov., female wing.
68. *Pentaneura melanops* Meigen, female spermatheca.
69. *Pentaneura melanops* Meigen, female cercus.
70. *Pentaneura longipennis* sp. nov., female cercus.
71. *Pentaneura longipennis* sp. nov., female spermatheca.
72. *Pentaneura japonica* sp. nov., female cercus.
73. *Pentaneura japonica* sp. nov., female spermatheca.
74. *Pentaneura alba* sp. nov., male hypopygium.
75. *Pentaneura alba* sp. nov., female spermatheca.
76. *Pentaneura alba* sp. nov., female cercus.
77. *Pentaneura monticola* sp. nov., male hypopygium.
78. *Pentaneura monilis* Linnæus, female cercus.
79. *Pentaneura monilis* Linnæus, female spermatheca.
80. *Pentaneura monilis* Linnæus, male hypopygium.

PLATE 5

FIG. 81. *Heptagyia eburnea* sp. nov., female wing.
82. *Heptagyia nipponica* sp. nov., female wing.
83. *Syndiamesa (Syndiamesa) bicolor* sp. nov., female wing.
84. *Diamesa (Diamesa) plumicornis* Tokunaga, female wing.
85. *Pentaneura longipennis* sp. nov., male hypopygium.
86. *Pentaneura divisa* Walker, male hypopygium.
87. *Pentaneura kyotoensis* sp. nov., male hypopygium.
88. *Pentaneura maculipennis* Zetterstedt, male hypopygium.
89. *Pentaneura melanops* Meigen, male hypopygium.
90. *Pentaneura multifascia* sp. nov., male hypopygium.
91. *Pentaneura octopunctata* sp. nov., male hypopygium.
92. *Syndiamesa (Lasiodiamesa) crassipilosa* sp. nov., female cercus.
93. *Syndiamesa (Lasiodiamesa) crassipilosa* sp. nov., female spermathecæ.
94. *Diamesa (Diamesa) plumicornis* Tokunaga, female cercus.
95. *Diamesa (Diamesa) plumicornis* Tokunaga, female spermatheca.
96. *Syndiamesa (Syndiamesa) bicolor* sp. nov., female cercus.
97. *Syndiamesa (Syndiamesa) bicolor* sp. nov., female spermathecæ.

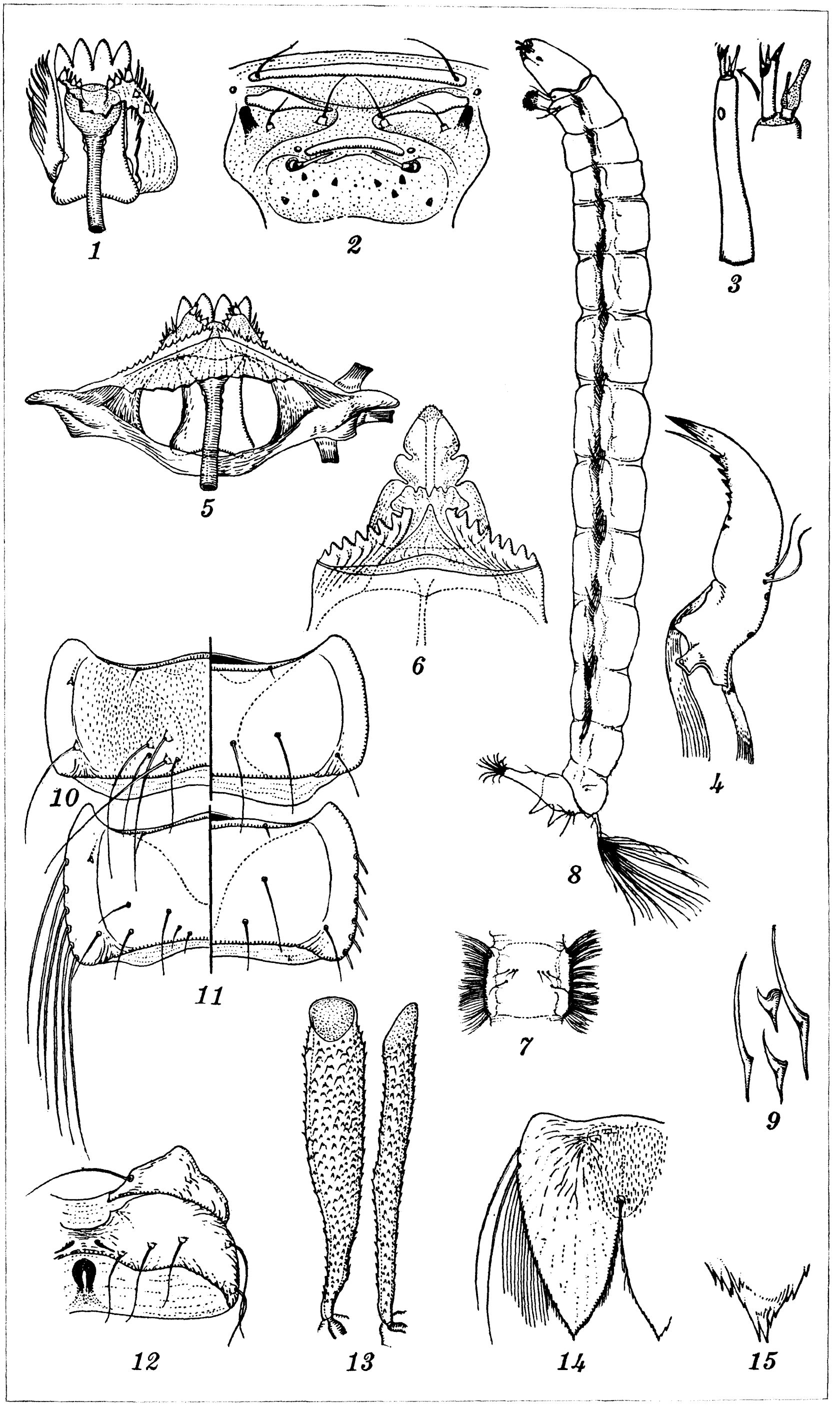

PLATE 1.

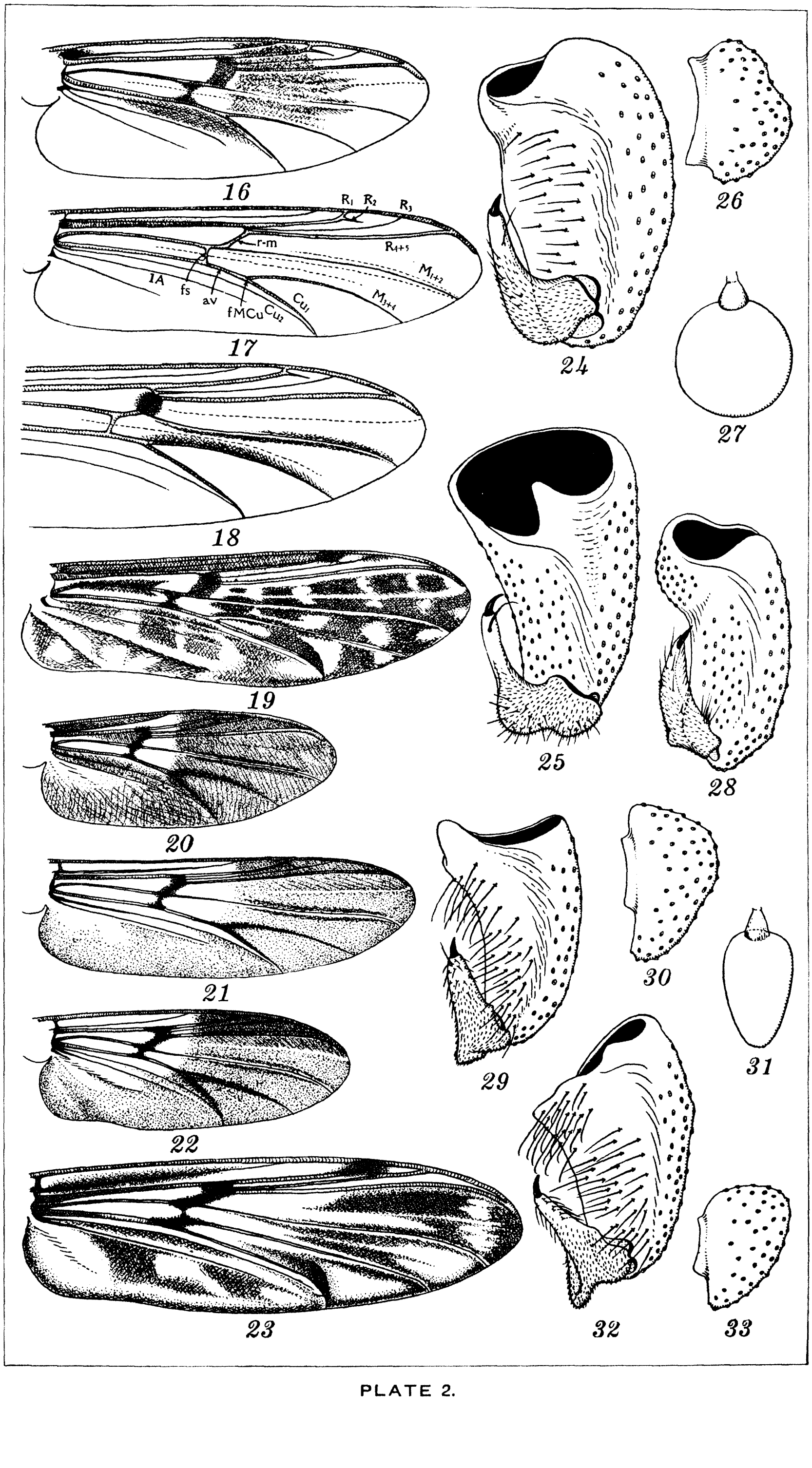
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PLATE 2.

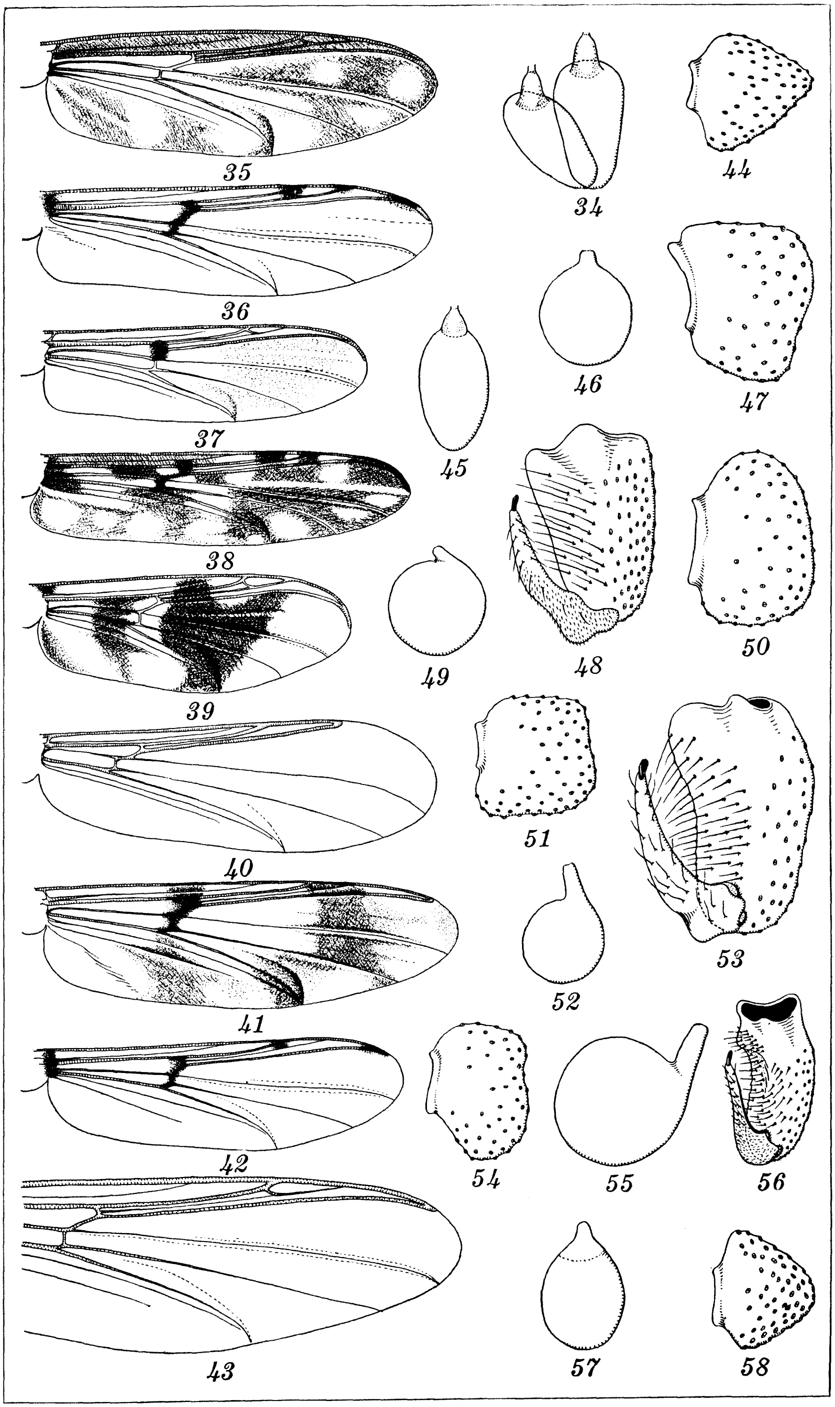
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PLATE 3.

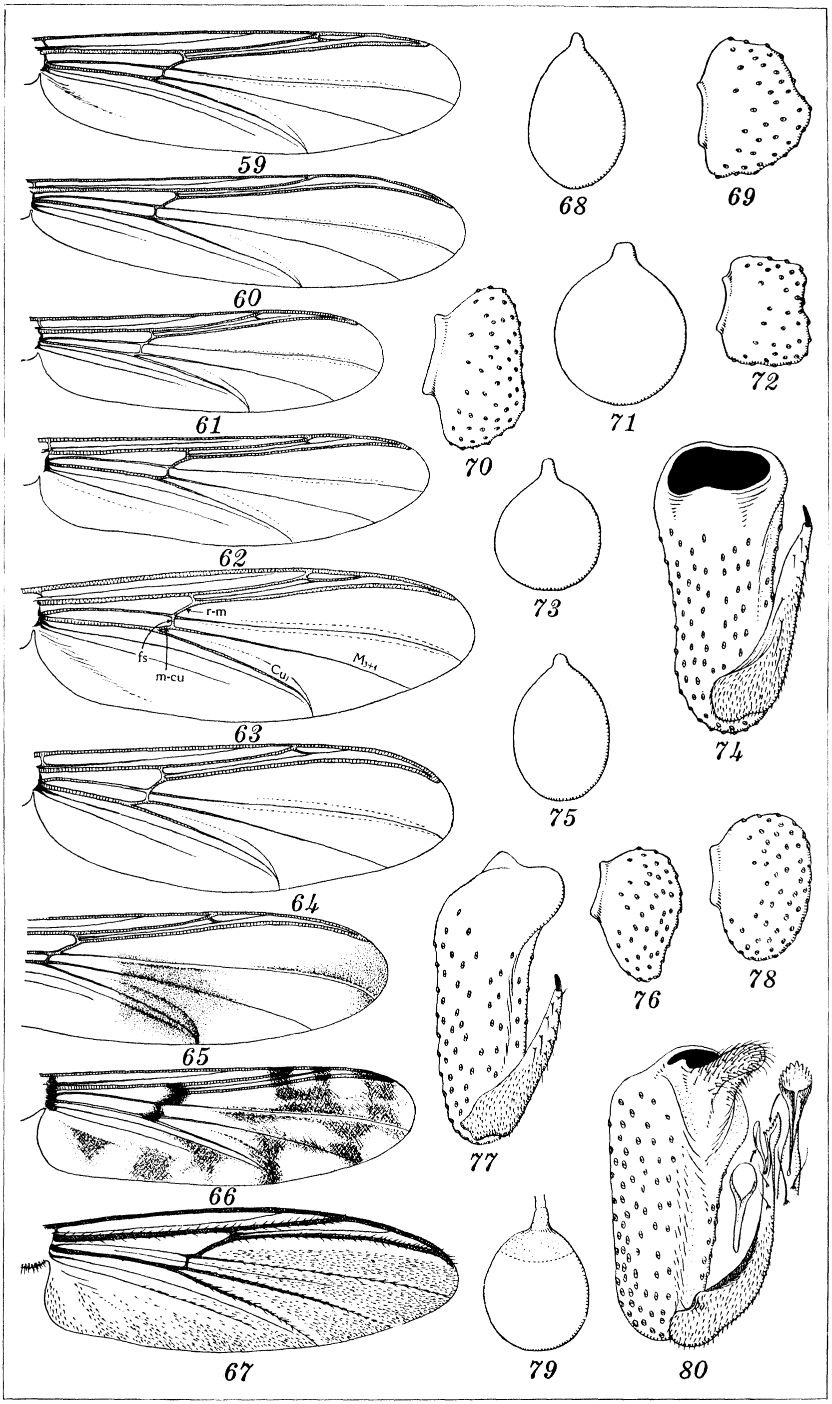
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PLATE 4.

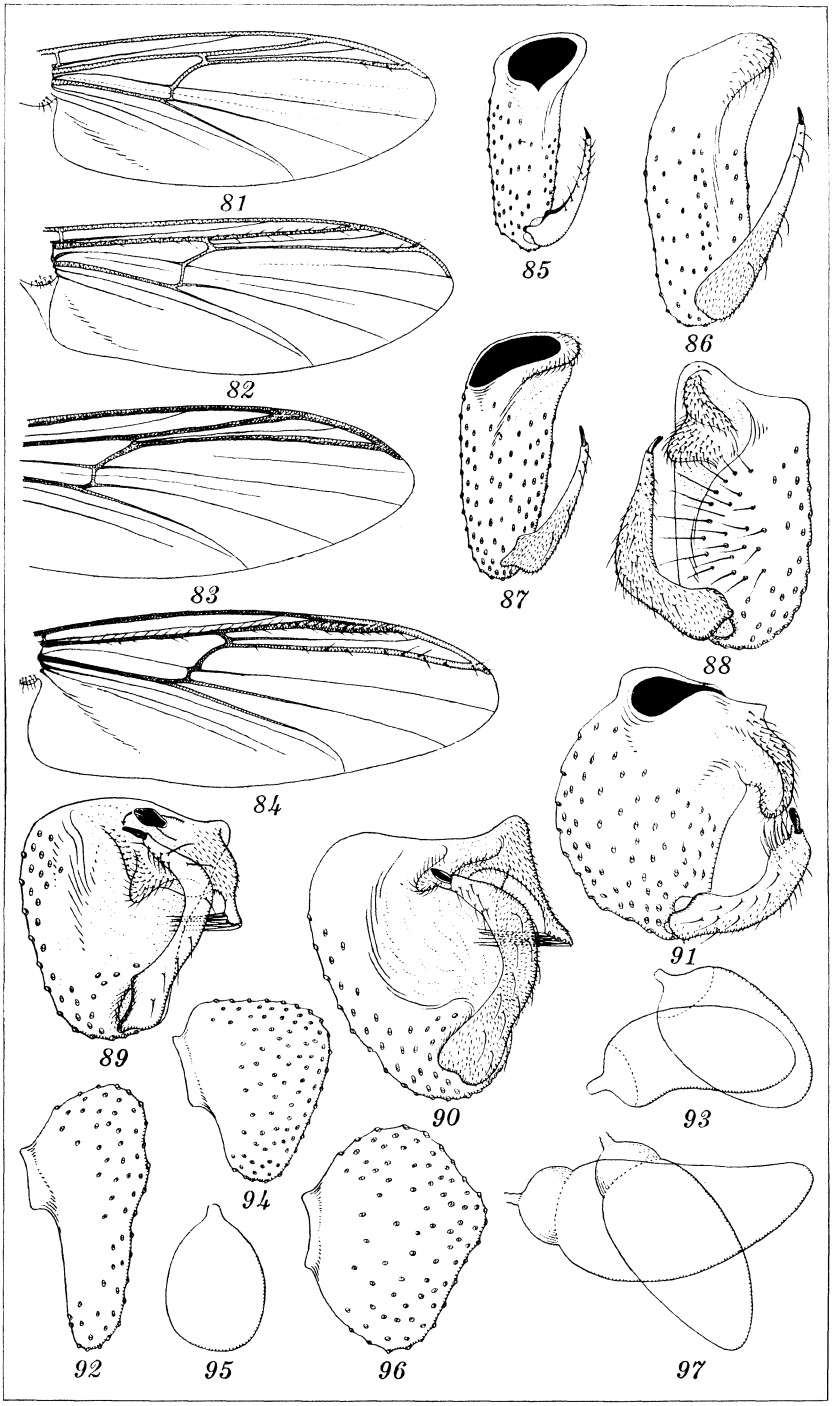

PLATE 5.

ILOKO CONSTRUCTIONS

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EIGHT PLATES

In the present paper we shall try to describe as accurately as possible the different parts of—

The Iloko house.—Under this heading will be included a few parts of granaries and other buildings, which have special names.

The Iloko cart.—Under this heading will be included a few other vehicles or means of conveyance possessed by the Iloko. Water craft has been discussed in a previous paper.[1]

In both lists we shall arrange the names alphabetically, so that they will be of greater use to the missionary or explorer who has to learn the Iloko language. At the same time we shall give under each name the necessary references, so as to make matters clear to all readers.

We shall include only native Iloko names, of course, and, although we shall give only those that came to our personal notice, we are convinced that the subject will be treated rather thoroughly, and that our paper will cover practically the whole field we intended to explore. Iloko furniture and implements may be treated later.

THE ILOKO HOUSE

abúlog. The fence, generally made of light bamboo (*bólo, Schizostachyum mucronatum*), which incloses the space under the house (*sírok*), between the ground and the floor. This fence is only to be found in well-kept houses; in most cases the *álad* or fence around the yard or garden is the only inclosing barrier.

abút. Hole, pit, etc.; for example, the hole dug in the ground for the reception of a post (*adígi* or *sin̄git*); a hole in the roof, in the floor, in the walls, etc.

adígi. Any of the principal posts on which the whole frame or skeleton of the house is built. They are generally planted in the ground, sometimes, but rarely, set on supplementary stones, or blocks of wood, masonry, or cement. They always reach the tiebeams (*awanán* and *sekkég*), which fit in mortises (*paran̄gáw*) prepared at the upper part of the *adígi*. The part of the *adígi* from the ground up to the floor is visible from outside, provided that no *abúlog* or fence has been con-

[1] Anthropos 22: 240–243.

structed, while the part of the *adígi* from the floor up to the tie-beams is visible only from inside. The *adígi* that are situated at the corners (usually four) are called *dógo;* the others, *bayábay*. Cf. *síñgit*. (See Plate 2, fig. 7, *a;* Plate 3, figs. 9, *a, b;* 10, *c;* 11, *a;* Plate 5, fig. 22, *a, b;* Plate 7, figs. 30–32.)

agámañg. Granary. The *agámañg*, called *sarúsar* in some districts, is generally more or less of the same type of construction as the ordinary house. Its shape is usually that of an upturned, truncated, rectangular or square pyramid resting on four posts (*síñgit*), and covered with a roof of the *tinúbeñg* type or gable roof. (See Plate 3, fig. 12.)

agdán. Ladder; stairs or staircase. All Iloko houses have either a ladder, which is generally made of heavy bamboo (*kawáyan, Bambusa blumeana*, etc.), sometimes of timber, or, rarely, a staircase made of timber, masonry, or concrete. In ordinary bamboo ladders the side pieces (*baútek*) are complete, round sections of bamboo, and the rungs or steps (*tukád*) are parts of a section of bamboo cut lengthwise. Besides the rung that fits in the side pieces, the Iloko sometimes add a second crosspiece, which they tie or nail to the side pieces in front of each simple rung. In a few cases, instead of bamboo, timber is used either for the single rungs or for the double ones, or for one part of the double ones. (See Plate 5, fig. 21.)

agsít. Layer of nipa leaves (*Nipa fruticans*) or of cogon grass (*Imperata cylindrica*), used for thatching. An ordinary layer is usually from four to five feet long. The nipa leaves are strung on and tied to a lath of bamboo, while the cogon grass is pressed between two laths of bamboo, both at its lower part (*sigpít*) and about the middle (*puñgán*). The tops of either the nipa leaves or the cogon grass hang loose. These layers are tied to the rafters in rows (*kásaw*) running horizontally all along the roof; they are superposed in such a way as to leave about five inches between the upper part of each layer and the next one. It goes without saying that the tops of the leaves or of the grass hang downward and that the first and undermost layers or rows of layers are situated at the eaves, the succeeding ones ascending gradually towards the ridge of the roof. Cf. *pinaúd* and *payák*. (See Plate 6, fig. 27.)

akílis. Strips of rattan used to tie together laths of bamboo, so as to form extensive layers, mostly used in flooring. The laths of bamboo are placed in juxtaposition, and in several places, at distances of from one to two feet, they are tied together by a strip of rattan running in a straight line. The whole outfit, the laths of bamboo and the rattan strips that keep them together, is called *inakílis*. (See Plate 6, fig. 26, *f*.)

alintúboñg. Any of the small pieces of heavy bamboo attached to the walls of the house, at the outside, at about the height of the upper part of doors and windows. There are at least two such pieces to each wall, one at each corner, and a supplementary *alintúboñg* is placed between each door or window and the next one. These pieces serve as supports for the *alotoótan*, which passes through the hole situated at or near the center of each *alintúboñg*. In some houses,

however, the *alotoótan* are simply tied to the wall or to some part of the eaves, in which case no *alintúbon̄g* is necessary. (See Plate 1, fig. 2, *g*.)

alotoótan. Any of the bamboos that run horizontally along the wall of the house, at the outside, a little higher than the upper part of doors and windows. They serve as supports for the common shutters (made of light materials: bamboo, nipa, etc.) of doors and windows, whose upper part slides over the *alotoótan*, whenever a door or window has to be opened or closed. (See Plate 1, fig. 2, *f*.)

appút. The pieces of timber that run all along the eaves, underneath, covering the extremities of the projecting ceiling joists. These joists, which extend beyond the walls of the house and reach the eaves, end in tenons, and, consequently, mortises are made in the *appút* in front of each joist. As these projections of the ceiling joists are absent in the majority of Iloko houses, the *appút* are of rather rare occurrence.

atép. Roof. This term includes only the roofing, that is: cogon, nipa, corrugated iron, etc., not: the rafters, etc. Cf. *ólo*.

awanán. Either of the two tie-beams that run from one *dógo* or corner post to the other, under the lower part of the *bayakán* (trapezoid or rectangular side of the roof). When the floor plan of the building is a square, the two *awanán* and the two *sekkég* are identical; but when the floor plan is a rectangle, which is the case in the great majority of Iloko buildings, the *awanán* are much longer than the *sekkég*. Cf. *sekkég*. (See Plate 1, fig. 1, *a*; Plate 3, figs. 9, *f*; 10, *n*; 11, *c*; 12, *c*; Plate 6, fig. 28, *c*.)

b(in)akúl. Twilled; the ordinary way of weaving light bamboo into large sheets, whether close-woven (*tidtíd*) or open-worked (*minatá*): each bamboo or strip of bamboo runs alternately over and under two (not one) transverse bamboos. It is chiefly used for walling (*tidtíd*), flooring (*tidtíd*), and roofing (*minatá*) purposes. Cf. *sinará*. (See Plate 1, fig. 2, *c*; Plate 5, fig. 23; Plate 6, *fig*. 26, *g*.)

balatbát. The bamboos that run horizontally all along the roof, across all the rafters, at the inside, about halfway between the walls and the ridge of the roof. They correspond more or less to our purlins. The real *balatbát* occur only in houses of the *pinagón̄g* type; the corresponding bamboos, which are generally three instead of one, in houses of the *tinúben̄g* type, are called *lalabáyan*.

The same name is applied to the flattened bamboo that runs all along the edge of a section of woven bamboo (*tidtíd*), in order to cover this edge and give the whole section a neater appearance. (See Plate 1, fig. 2, *e*.)

baláy. House, dwelling, residence, habitation, abode. A perfect Iloko house consists of three main parts: the house proper or *kadaklán* with its own separate roof, the kitchen or *kosína* (Spanish: *cocina*), and the *batalán* which connects the two. In almost all Iloko houses the kitchen is separated from the main building and has its own roof; but the shape, size, and situation of the *batalán*, if it exists at all, is exceedingly variable, as will be seen in due time. (Plate 2, fig. 8.)

The term *baláy* is sometimes applied to the sitting room or *teñg-ñgá*.

ballóloñg. Head of a frame. In houses whose window sashes and doors are made of timber, the *ballóloñg* is the highest piece in a door frame or window frame, and it runs through from one end of the wall to the other. In houses that have shutters made of bamboo, the *ballóloñg* is the part of the wall, above a door or window, to which the head *talañgkúb* is applied. Cf. *talañgkúb*. (See Plate 1, fig. 3, *a*.)

balunét. A bar of timber or heavy bamboo used to fasten ordinary doors and window shutters (made of light materials) from inside. Doors and window shutters hang loose from the *alotoótan* and, consequently, are easily lifted up outward from beneath. To prevent this, a ring of rattan is fixed about their center, at the inside, in order to hold the *balunét*, which passes through that ring and, being longer than the width of the door or window, presses with both extremities against the uprights of the frame at the inside. See Plate 1, fig. 3, *c*.

(pagba)bañgá(an). Any place on the *bañgsál* where rice is washed and *báñga* are cleansed. *Báñga* are round, earthen pots with a round bottom, in which rice is cooked. The combination *pag . . . an* is a locative. The reduplication indicates habit, custom, easiness or readiness in performing an action, etc.

bañgén. A small, low, fencelike device, made of bamboo and placed upright over the doorsill or threshold. It is high enough to prevent small children from getting out and tumbling down the ladder, and low enough to allow older children and adults easily to step over it.

The same name is applied to the ensemble of horizontal bars of timber or bamboo that close the gates used in fences. (See Plate 2, fig. 4, *a*.)

bañgkíl. The hook that keeps sliding doors and windows shut from inside, and the bar of timber or bamboo that keeps folding doors and windows shut from inside. (See Plate 2, fig. 5, *a*.)

The same name is applied to a piece of iron, wood, etc., used to twist and tighten a rope that has to serve as a clamp. (See Plate 2, fig. 6, *a*.)

bañgsál. An annex to the kitchen consisting of a kind of platform raised on posts (*síñgit*) and not covered by any kind of roof. This platform generally consists of a certain number of unsplit bamboos with more or less large interstices between them, and it is usually lower than the floor of the kitchen, never higher. On the *bañgsál* are placed the large earthen jars which contain the water to be used for cleansing and bathing purposes. There pots and pans, rice, vegetables, etc., are cleansed; palay, meat, fish, etc., are dried in the sun; people bathe, urinate, etc. (See Plate 2, fig. 8, *d*.)

baríkes. Horizontal beams that run all around the house, either inside or outside or both, about halfway between the tiebeams and the floor, at the height of the window sills, and to which the walling of the house is nailed or tied. The *baríkes* is absent in some houses, and in others it is replaced by the *paladpád*. (See Plate 2, figs. 7, *c*; Plate 3, fig. 9, *g*.)

básar. A kind of floor or flooring made of rather large strips of

heavy bamboo, which are tied together as described under *akílis*, rarely nailed to the joists. The interstices between the laths of bamboo are much larger in the *básar* than in the *datár*, and sometimes a second flooring or *daplát*, made of woven bamboo or *tidtíd*, covers the *básar*. The *básar* is also used to make benches, beds, etc. (See Plate 6, fig. 26, *e*.)

batalán. One of the three principal parts of a perfect Iloko house, very often in the form of a penthouse. Its size and shape are exceedingly variable, and it very often directly connects the kitchen with the *kadaklán* or main building. Sometimes the *batalán* is entirely absent, but, wherever it exists, it is situated somewhere between the kitchen and the *kadaklán*. In some houses the *batalán* has its own roof, different from both the roof of the kitchen and that of the *kadaklán;* in others, at least a part of the roof of the *batalán* is a direct continuation of one or two of the slopes of the roof either of the kitchen or of the *kadaklán* or of both. The main door of the house, where the ladder is placed, usually opens on the *batalán*, so that one has to pass through a part of the latter when entering the house and going either to the kitchen or to the main building. The *batalán* very often serves as a dining room, and sometimes as a waiting room for peddlers, beggars, etc. (See Plate 2, fig. 8, *b*.)

batáñgan. Any of the four horizontal beams of the granary, that connect the four posts (*síñgit*) at the height of the floor. The *batáñgan* correspond to the combined *lipít* and *patapáya* of the house, but they end in tenons, fitting in mortises cut in the *síñgit* or posts, which is not the case with the *lipít* and *patapáya*. (See Plate 3, fig. 12, *d*.)

batañggá. Any horizontal piece of timber or bamboo which serves as a temporary support for something else. For example: a piece of timber or bamboo tied to the wall of a house, and on which stands or sits a person who has to do some work at a place he cannot reach otherwise; a piece of timber or bamboo attached to a post, a tree, etc., and on which is laid a beam, a tree, etc., that has to be sawed, etc.

baútek. Side piece of a ladder; side piece of a door or window shutter, whose frame is made of bamboo. *Baútek* also means "I whip;" from the stem *báut* (whipping), the suffix *en* (reduced to *e* when followed by the possessive of the first or second person singular) of substantival verbs, and the possessive of the first person singular *ko* (reduced to *k* when following a vowel). Cf. *agdán*. (See Plate 1, fig. 2, *d;* Plate 5, fig. 21, *a*.)

bayábay. Any of the principal posts or *adígi* of the house, except the *dógo* or corner posts. Cf. *adígi* and *dógo*. (See Plate 3, fig. 9, *b;* Plate 5, fig. 22, *b;* Plate 7, figs. 30, 31.)

bayakán. Either of the two trapezoid (in houses of the *pinag-óñg* type) or rectangular (in houses of the *tinúbeñg* type) sloping sides of the roof. A *bayakán* extends from one of the *awánan* tiebeams to the ridge of the roof. Cf. *ólo* and *sóba*. (See Plate 3, fig. 9, *k;* 10, *k;* 11, *b*.)

(bayañg)báyañg. The gable or vertical, triangular portion of the wall (in houses of the *tinúbeñg* type), that extends from the *sekkég* tiebeam to the ridge of the roof. The base of the *bayañgbá-*

yañg is the *sekkég;* the two other sides are the *solókan* rafters, and its apex is at the ridge of the roof. (See Plate 3, fig. 9, *l.*)

bekkér. The *bekkér* or *síkañg* is a tiebeam, parallel with the two *sekkég.* Like the latter it connects both *awanán;* but, instead of running between two *dógo* or corner posts, like the *sekkég,* the *bekkér* runs between two *bayábay.* (See Plate 1, fig. 1, *c.*)

bennég. The horizontal beam which is placed over the floor and on which is raised the partition between the sitting room (*teñg-ñgá*) and the sleeping rooms (*silíd*). It generally runs parallel with and immediately under a *bekkér* tiebeam.

biríñg. The strip or strips of rattan used to bind together a principal post or *adígi* and some important horizontal beam, for example: an *awanán,* a *sekkég,* a *patapáya,* etc.

(pam)iriñg(án). A hole in an *adígi* or principal post, an *awanán,* a *sekkég,* a *patapáya,* etc., through which passes a *biríñg.* The combination *pañg . . . an* is a locative; the final *ñg* of the prefix is combined with the initial *b* of the stem into *m.*

bobóñg. Ridging: thatch, nipa leaves, etc., that cover the ridge of the roof.

boboñg(án). The two beams at the ridge of the roof, namely: the *sallabáwan,* on which the rafters rest, and the *pakabáyo* (from the instrumental prefix *pa* and the Spanish *caballo,* horse), which rests upon the rafters. The latter runs parallel with the *sallabáwan* and is covered with the *bobóñg* or ridging. *Boboñgán* (locative suffix *an*) literally means "that on which the *bobóñg* rests." Cf. *tul-óng.* (See Plate 4, fig. 13.)

busór(an). A girder supporting the floor joists; it is either a piece of timber or a heavy bamboo. *Búsor* literally means "enemy;" the suffix is a locative. (See Plate 6, fig. 26, *b.*)

(ka)dakl(án). The principal part of the house, the house proper. The *kadaklán* has its own roof, and is either of the *tinúbeñg* type with a gable roof, or of the *pinagóñg* type with a hip roof. Its floor plan is generally a rectangle, rarely a square. *Dakkél* means "large, great;" *kadakkelán* or *kadaklán* means "the largest." Cf. *laém.* (See Plate 2, fig. 8, *a.*)

(pagda)dalikan(án). The place around the hearth. As the Iloko have no word for kitchen (which they call *kosína,* Spanish *cocina*), it is very probable that formerly the hearth was situated somewhere in a corner of the *laém,* as is still the case in a few Iloko houses and in most all houses of the so-called non-Christian tribes. *Dalikán* means "hearth;" the combination *pag . . . an* is a locative; the reduplication indicates habit, custom, easiness, or readiness in performing an action, etc.

dapián. A loose board or other piece of timber placed on the floor at the entrance of the house, near the ladder, and also at the entrance of any part of the house whose floor is lower than the rest. The *dapián* more or less corresponds to our doorsill or threshold, as it is situated over the first part of the floor one treads upon, when entering either the house, by the ladder, or any part of the house, whose floor is lower than that of the place one comes from.

daplát. A layer or sheet of woven bamboo, used for flooring (*tidtíd*) and roofing (*minatá*) purposes. It is generally laid immediately

over the *básar* (*tidtíd*) or under the roofing (*minatá*). (See Plate 6, fig. 26, *g*.)

datár. A kind of floor or flooring made of rather small and thin strips of heavy bamboo tied together as described under *akílis*. The interstices between the laths of bamboo are almost negligible, which is not the case with the *básar*. The *datár* is much nicer than the *básar*, even though the latter be covered with a *daplát*, and the floor of the sleeping room or that part of the *laém*, where the inmates sleep, is ordinarily made of *datár*, although all the rest be *básar*.

Nowadays, the term *datár* very often stands for floor in general. Sometimes, however, especially when the floor is made of boards, the Spanish term *suelo*, floor, is used.

dellég. The ensemble of floor joists of heavy bamboo. Floor joists of timber are generally called *soléras* (Spanish). (See Plate 6, fig. 26, *c*.)

(ka)dsaár(an). The floor as a whole. It consists of the *busóran*, the *delleg* or *soléras*, the *pang̃arásan*, and the *básar* (with or without *daplát*) or *datár*. From the stem *dessáar*, "placing on the floor," and the locative *ka . . . an*. (See Plate 6, fig. 26.)

didíng̃. Wall (of a house, a room, etc.). The exterior walls are generally made of light bamboo, either *taléb* or *tidtíd;* sometimes of nipa, boards, etc. Partitions are usually made of *tidtíd*, sometimes of boards.

dógo. Any of the corner posts. They are usually four. Cf. *adígi* and *bayábay*. (See Plate 2, fig. 7, *a;* Plate 3, figs. 9, *a;* 10, *c;* 11, *a;* Plate 5, fig. 22, *a;* Plate 7, fig. 32.)

duág. Appentice or penthouse. A lean-to roof attached to and sloping from a wall, as one sheltering a staircase, a balcony, a lean-to, etc. Cf. (*pa*)*taguáb*.

gálut. Anything (mostly strips of rattan or of bamboo) that is used for binding or tying purposes, at any part of the house, the granary, the fence, etc. Cf. *biríng̃* and *rákab*.

kádang̃. The eight pieces of timber that run crosswise from the top of one *paransúgay* to the base of the next one. The *kádang̃* form four irregular Saint Andrew's crosses, one at each side of the granary. (See Plate 3, fig. 12, *b*.)

kalapáw. Hut, hovel, shed. Any small, roofed shelter, with or without walls, made of light materials, as bamboo, reed, cogon, nipa, etc., and used as a temporary shelter for passing the night; in the daytime, as a shelter from where birds are frightened away from the ripening harvest; as a dwelling while guarding the growing crop, etc. Sometimes, however, the whole family goes to live in the field, at the time of the ripening and harvesting of the crop; in which case the *kalapáw* is more or less a replica of an ordinary simple Iloko house. It should be noted that a polite Iloko will always call his house, be it a hovel or a palace, his *kalapáw*.

kamáng̃(an). Joint. Any place or part where two pieces of timber, bamboo, etc., are united. For example: the place where a rafter rests on a tiebeam. *Kámang̃* means "refuge;" the suffix is a locative. Cf. (*pag*)*sang̃ál*(*an*). (See Plate 4, fig. 18.)

(ka)kapt(án). Rail. A bar of timber or bamboo, situated at one or at both sides of the ladder, and

taken hold of by people mounting the latter. Its upper end is generally attached to one of the uprights of the door frame, about halfway; and its lower end to a short, slender post of timber or bamboo (the newel), which is attached to one of the side pieces of the ladder, or planted in the ground at its foot. In more elaborate staircases, the *kakaptán* is a real balustrade. *Kapét* means "sticking to, taking hold of;" the combination *ka . . . an* is a locative.

(pagka)karambá(an). The place where the *karámba* are located, resting on their supports. It is generally situated in the kitchen, sometimes on the *bañgsál*, rarely elsewhere. The *karámba* are rather large, round earthen jars with a round bottom, in which water is kept for drinking purposes. The combination *pag . . . an* is a locative. The reduplication indicates habit, custom, easiness or readiness in performing an action, etc.

kásaw. A row of layers of nipa leaves or cogon grass, used for thatching. Cf. *agsít*.

káwad. Wooden pegs, stuck in the posts, to prevent them from moving to and fro. Wherever *káwad* are used, several of them are driven in each post all around, in the section that is planted in the ground, not far from the surface, above which the *káwad* never protrude. *Káwad* also means "groping, etc."

(pa)kikít. Jack rafter: a short rafter that extends from a *solókan* to a tiebeam (*awanán* or *sekkég*), in hip roofs (*pinag-óñg*). *Kikít* means "little finger;" the prefix is an instrumental. (See Plate 3, fig. 10, *h*.)

(kinsi)kínsi. Any ornamentation of the exterior walls (made of boards) of the house, which consists in a combination of comparatively small pieces of timber worked into various designs. The *kinsikínsi* is visible only from outside, and covers only the lower part of the house up to the windows. It very often takes the place of the wall under each window, where wooden shutters opening inside cover the *kinsikínsi*. It is also found in balustrades or *barandílias* (Spanish: *barandillas*), where it takes the place of balusters, along the edge of a balcony, terrace, staircase, etc. The term *kinsikínsi* is probably not genuine Iloko. In Spanish *quince* means: fifteen. The reduplication occurring in *kinsikínsi* indicates either resemblance or repetition of an action. (See Plate 4, figs. 14–17.)

(pa)kokó. The notched lower part of a rafter, that rests upon a tiebeam (*awanán* or *sekkég*). *Kokó* means "nail, claw;" the prefix is an instrumental. (See Plate 4, fig. 18, *c*.)

koribatóñg. The vertical laths of timber or bamboo which are found all along the walls of some houses at the outside. These laths are attached to the wall at equal distances from one another, and generally run from the *patapáya* up to the *baríkes* or the *paladpád*, sometimes also from the *paladpád* up to the *ballóloñg*.

The same name is applied to the stone or plumb bob of a plumb line, used in the erection of new houses. The Iloko attach this plumb line to a beam somewhere in the center of the frame, in order to see if the house stands straight. To understand this, it should be remembered that the

building of an Iloko house starts with the planting of the posts or *adígi* and the building of the roof or *ólo*.

kulintípay. Concha, a piece of translucent shell used for window glass, generally about three inches square. The *kulintípay* are set in wooden frames or sashes (usually from two to four to each window), which are of a great variety of dimensions. These window sashes occur only in houses whose walls are made of boards, and they generally slide over the *paladpád*, at the outside, when opened or closed. (See Plate 4, fig. 19, *a.*)

(la)labáy(an). The three parallel bamboos that run horizontally at equal distances from one another, all along the roof, across all its rafters, at the inside. The real *lalabáyan* occur only in houses of the *tinúbeñg̃* type (gable roof). The corresponding single bamboo, in houses of the *pinag-óñg̃* type (hip roof), is called *balatbát.*

The term *lalabáyan* is also applied to a kind of X-shaped frame, on which cotton yarn is prepared for skeining. *Lábay* means "skein;" the suffix is a locative; the reduplication emphasizes the meaning.

ladét. Any of the supplementary rafters occasionally placed upon the ordinary rafters (*pasañg̃gír*, *solókan*, etc.), and reaching from the eaves up to a point at a certain distance from the top of the ordinary rafters. Wherever *ladét* occur, the ordinary rafters rest with their lower end on the inner edge of the tiebeam or pole plate (which is generally also the wall plate), while the *ladét* rest on the outer edge. (See Plate 4, fig. 20, *d.*)

In this connection it seems opportune to give the meaning of three terms, which are not genuine Iloko, and which regularly occur in documents written in Spanish.

> *kílo* [Spanish(?) *quilo*]: ordinary rafter.
>
> *sobrekílo* [Spanish(?)] sobrequilo, from the Spanish *sobre,* over, upon, and *quilo*): the same as the Iloko *ladét.*
>
> *barakílan* [Spanish(?) *baraquilan* or *varaquillan*]: any of the horizontal pieces of timber that cross the *sobrekílo* at regular intervals, and to which the sheets of corrugated iron, etc., are secured immediately.

laém. The principal part of the house, the house proper. This term refers only to the space between the exterior walls, while the term *kadaklán* (which see) refers to the whole building and includes the roof, the posts, etc. In some houses the *laém* has only one room that serves as sitting room, sleeping room, etc. In a perfect Iloko house, however, one or more partitions separate the sitting room, called *teñg̃ñg̃á* or *sálas*, from one or more sleeping rooms, called *silíd* or *sopí.* Sometimes, especially when the *laém* has only one room, one or more annexes, called *sagumbí,* open into it and serve as sleeping rooms, storerooms, etc. *Laém* literally means "inside." (See Plate 2, fig. 8, *a.*)

lansá. (Metal) nail, (wooden) peg.

(ka)lasúg(an). Gutter, eaves channel, eaves trough. *Kalasúgan* occur chiefly inside the house; they are fixed under any place where the eaves of two slopes, pertaining to different roofs, meet each

other; for examples, between the *batalán* and the kitchen. The *kalasúgan* usually consists of one or more heavy bamboos split into halves. Other gutters are rare.

líbeñg. A piece of earthenware in the shape of a *karámba* or large earthen jar, which is often found fixed near the top of each of the four posts (*síñgit*) of a granary, not far from the floor, in order to prevent rats from climbing up along the posts and entering the granary.

(li)liktád(an). A strip of rattan, a rope, etc., that prevents the ladder from falling backwards, when its top has been removed from the doorsill on which it rested, which is done to keep dogs, etc., from entering the house, and to indicate that the inmates are out or do not want visitors. *Liktád* means "removing the ladder" (as described above); the suffix is a locative; the reduplication emphasizes the meaning. (See Plate 5, fig. 21, *d.*)

lipít. The innermost of the two beams that run parallel with the tiebeams (*awanán* or *sekkég*), the *baríkes*, etc., and connect two *dógo* or corner posts at the height of the floor. The outermost of the two beams is called *patapáya*. The *lipít* are covered by the flooring, while the *patapáya* serve as supports for the walling. *Lipít* means "pressing between." Cf. (*pa*)*tapáya*. (See Plate 5, fig. 22, *c;* Plate 6, fig. 26, *a.*)

m(in)atá or **(mata)matá.** Openworked. Applied to woven bamboo, whether *binakúl* (twilled) or *sinará* (checker). It is used mostly for the *pasaplák*. *Matá* means "eye;" the reduplication indicates resemblance; the infix *in* either indicates resemblance or means "made of." Cf. *tidtíd* and (*pa*)*saplák*. (See Plate 5, figs. 23, 24.)

óboñg. Pigsty, pigpen. A small inclosure for swine, situated at some distance from the house. It consists of a miniature house of the *tinúbeñg* type, with two openings, one at each gable, both *bayañgbáyañg* being absent. Its ground plan is a rectangle, not much larger than the inclosed animal; its height is proportioned to that of the owner, so as to allow him to pass the food through the opening at the gable. The walls consist of horizontal bamboos, perforated at both ends, and kept together with vertical strips of bamboo passing through the holes. The floor, which is about one foot above the ground, generally consists of bamboos connected in the same way as those of the walls. (See Plate 6, fig. 25.)

ólo. Roof. This term includes the roofing and all the materials and construction (*atép* and *sokóg*) necessary to carry and maintain the same upon the posts (*adígi*) and tiebeams (*awanán* and *sekkég*). There are two kinds of roofs: the hip roof, with two trapezoid sloping sides (*bayakán*) and two triangular sloping ends (*sóba*), which is typical of the *pinag-óñg* houses; and the gable roof, with two rectangular sloping sides (*bayakán*), which is typical of the *tinúbeñg* houses. *Olo* also means "head." Cf. *p*(*in*)*ag-óñg* and *t*(*in*)*úbeñg*. (See Plate 3, figs. 10, 11.)

padiñgán. Any disconnected small extent of walling, generally about one foot in width. For example: that which covers the space between a post or *adígi* and the nearest upright of a door frame.

p(in)ag-óñg. A house with a hip roof. Both ends (*sóba*) and both

sides (*bayakán*) of the roof are sloping, and there are no gables or *bayan̄gbáyan̄g*. *Pag-ón̄g* means "turtle;" the infix indicates resemblance. Cf. *t(in)úben̄g*. (See Plate 3, fig. 10.)

paladpád. Window sill. In houses whose window sashes are made of timber the *paladpád* is the lowest piece in a window frame, and it runs through from one end of the wall to the other, taking the place of the ordinary *baríkes*. In houses that have shutters made of bamboo, the *paladpád* is the part of the wall below a window on which the sill *talan̄gkúb* rests. Cf. *talan̄gkúb*. (See Plate 1, fig. 3, *b*.)

pálay. Any large wooden peg stuck in an *adígi* or post, and on which rests either a *patapáya* or a *lipít*.

pandág. A kind of framework of heavy bamboos placed over a nipa roof. The bamboos that run parallel with the rafters of the *bayakán* cross one another over the *bobon̄gán* or ridge. The latter are sometimes, although rarely, used to keep in place the *bobon̄gán* of roofs thatched with cogon grass. *Pandág* also means "pressing down."

Pandág is also another name for the *talan̄gkúb* of the ridge.

pantén̄g. A kind of hardwood very much esteemed, and used for posts, tiebeams, etc., in rich Iloko houses.

pan̄garásan. The strips of bamboo which are situated here and there between the bamboos of the *dellég* (floor joists), and which run parallel with the latter. As they do not rest on any support, they merely serve to connect the different parts of the *básar*, which are tied to them. No *pan̄garásan* appears in *datár* floors. This term is derived from some unknown stem (*áras* or *káras*) and the locative *pan̄g . . . an*. (See Plate 6, fig. 26, *d*.)

paradípad. The horizontal layer of *taléb*, placed between the wall and the *bayan̄gbáyan̄g* or gable in houses of the *tinúben̄g* type. A *paradípad* extends from one *dógo* or corner post to the other and serves as a support for the *bayan̄gbáyan̄g*. The bamboos of the *taléb* run perpendicularly to the vertical surface of the wall and *bayan̄gbáyan̄g*, and, although very short, project a little inside and outside of the house.

The term *paradípad* is also more or less an equivalent of our term "bustler;" it is applied to persons who are always on the move, but in a rather clumsy way, and continually collide with pieces of furniture, playmates, etc.

paransúgay. Any of the four vertical beams of the *agáman̄g* or granary, that extend from the tops of the four posts (*sín̄git*), at the height of the floor, to the *awanán* or tiebeams. The *paransúgay* stands in a slanting position and forms an obtuse outward angle with the *sín̄git*. The eight *kádan̄g* and the two *awanán* or tiebeams connect the *paransúgay* with one another. (See Plate 3, fig. 12, *a*.)

p(in)aúd. Any of the lowermost *agsít* or layers of nipa leaves or cogon grass, which make up the eaves. To form the *pinaúd* the *agsít* are doubled up towards the outside, so that the tops of the leaves or grass reach the upper part of the *agsít*, where they are tied to the latter. Consequently the width of a *pinaúd* is only about one-half of that of a common *agsít*. In some roofs the *pinaúd* are replaced by double *agsít*.

payák. Either of the two ends of the *agsít* or layers of cogon

grass, which are placed over the *solókan*. The mass of cogon grass situated at both ends of these *agsít* is much thicker than that which lies in the middle; it takes an outward direction and, consequently, an alar or winglike shape, hence the name *payák*, "wing." (See Plate 6, fig. 27, *b*.)

pokló. Angle brace: any short brace, acting as a strut and connecting two of the most important parts of the frame of a house. For example: the braces that connect two tiebeams (one *awanán* and one *sekkég*), two *patapáya*, two rafters, etc. Cf. *sakóbo* and (*pa*)*súli*. (See Plate 6, fig. 28, *a*, *b*.)

puñgán. The two strips of bamboo that keep the cogon grass of an *agsít* in place, about the middle. They run loose across both sides of the *agsít* and are tied together only at both ends. *Puñgán* also means "pillow." Cf. *sigpít*. (See Plate 6, fig. 27, *c*.)

(pa)raáñg(an). Cf. *parañgáan*.

rákab. The strip or strips of rattan used to bind a layer of bamboo (*taléb* or *tidtíd*) to the *adígi* or posts, the *baríkes*, etc. Cf. *gálut* and *biríñg*.

(pa)rákit. The bamboos or pieces of timber that run all along the eaves, covering the extremities of the rafters. (See Plate 3, fig. 10, *a*.)

The same name is applied to that part of a scaffold on which the workmen stand, and which consists of a few light bamboos tied together. A *rákit* is a raft made of a few bamboos tied together; the prefix is an instrumental.

(pa)rañgá(an). Porch, the entrance to the house or that part of the house yard where the ladder stands. It is generally covered with a *pataguáb*. A *ráñga* is a large earthen jar; the prefix is an instrumental and the suffix is a locative.

(pa)rañgáw. The mortise at the top of a post (*adígi* or *síñgit*), in which a tiebeam (*awanán* or *sekkég*) or some other piece of timber fits. A *dógo* or corner post has a double *parañgáw*, generally cut out on two neighboring sides; a *bayábay* has a single *parañgáw*, cut either on one side or through the middle; a *síñgit* may have a single *parañgáw* or a double one cut out on two opposite sides. The *rañgáw* are tops of young cucurbitaceous vines; the prefix is an instrumental. Cf. *tulóñg*. (See Plate 7, figs. 30, *a*; 31, *a*; 32, *a*; 33, *a*.)

(pa)rbó. The four rafters that meet the *solókan* at their upper end, near the ridge of the roof. The *parbó* occur only in hip roofs (*pinag-óñg*). See Plate 3, fig. 10, *f*.)

Parbó also means "(a house, etc.) constructed (by N.)," as opposed to "inherited."

(pa)rsá. A kind of scaffold consisting of an open-worked platform of bamboos or strips of bamboo, raised on posts and serving as a support for climbing vines, for example: bottle gourds, squashes, etc. It is an essential part of many vegetable gardens and is very often found near Iloko houses.

rídaw. The part of the house which is situated nearest to the entrance. A person who enters the house, stands in the *rídaw* immediately after he has passed through the door. This part of the house has obviously no definite limits.

rikép. Shutter, window sash, door. The movable frame or barrier of boards or other material; not: the

opening. (See Plate 1, figs. 2, *o;* 3; Plate 2, fig. 5; Plate 4, fig. 19.)

roáñgan. Door. The opening; not: the movable frame of boards or other material. (See Plate 5, fig. 21, *g.*)

sagumaymáy. Eaves. (See Plate 3, fig. 10, *m;* Plate 4, fig. 20, *b.*)

sagumbí. Annex, lean-to, penthouse, or to-fall. A wing or extension to a building, having a single-pitch roof and projecting from a house with a double-pitch or complete roof. The *sagumbí* opens into the *laém* or principal part of the house, and serves as a sleeping room, a storeroom, etc. It has no door communicating with the outside.

sakóbo. Angle brace: any of the braces that connect two tiebeams (one *awanán* and one *sekkég*). They are also called *pokló,* which is a more comprehensive term. (See Plate 6, fig. 28, *a.*)

sallabáwan. Ridgepole, the lower beam of the *boboñgán* or ridge of the roof. (See Plate 1, fig. 1, *d;* Plate 3, figs. 9, *j;* 10, *g;* 11, *g;* Plate 4, fig. 13, *a;* Plate 6, fig. 28, *e.*)

(sa)saloket(án). Any part of the wall, the door, etc., wherein something may be stuck. E. g.: all along the *baríkes* or *sigpít,* between the latter and a wall of bamboo (*taléb*). *Salokét* means "sticking something in a wall, etc.," as described above. The suffix is a locative; the reduplication emphasizes the meaning.

sánat. A kind of wooden wedge or peg used to fasten any part of the house. Specifically: the key of a scarf joint. (See Plate 7, fig. 29, *a.*)

(pag)sañgál(an). Joint, the place where two parts are joined or united. Specifically: the scarf joint in a post consisting of two pieces of timber. *Sáñgal* means "uniting;" the combination *pag- . . . an* is a locative. Cf. *kamáñgan.* (See Plate 7, fig. 29.)

(pa)sañggír. Rafter. *Pasañggír* is a generic name for all rafters. It is applied specifically to those rafters of the *bayakán* which extend from any part (except the two extremities) of the ridgepole to the *awanán* tiebeams. *Sañggír* means, "leaning against;" the prefix is an instrumental. Cf. *solókan, (pa)rbó, (pa)kikít,* and *tóbag.* (See Plate 1, fig. 1, *f;* Plate 3, figs. 9, *i;* 10, *e;* 11, *f;* Plate 4, figs. 13, *c;* 18, *a;* 20, *c;* Plate 6, fig. 28, *g.*)

(pa)saplák. A layer or *daplát* of open-worked or *minatá* woven bamboo that covers the rafters of some Iloko houses. It serves as a supplementary support for the thatch, and at the same time it is very ornamental and dispenses with the necessity of a ceiling or *bóbeda* (Spanish: *bóveda,* vault). *Saplák* means "extending;" the prefix is an instrumental.

s(in)ará. Checker. A certain way of weaving light bamboo into large sheets, whether close-woven (*tidtíd*) or open-worked (*minatá*). Each bamboo or strip of bamboo runs alternately over and under one (not two) transverse bamboo. The open-worked variety is chiefly used for roofing (*pasaplák*) and fencing purposes, to prevent chickens from entering the *bañgsál* or the garden. The close variety is sometimes used for walling purposes, in partitions, etc. (Cf. *b(in)akúl.* (See Plate 1, fig. 3; Plate 5, fig. 24.)

sarúsar. Cf. *agámañg.*

sekkég. Either of the two tiebeams which run from one *dógo* or corner post to the other, under the

lower part of the *sóba* (triangular part of the roof) or of the *bayañgbáyañg* (gable). Cf. *awanán.* (See Plate 1, fig. 1, *b;* Plate 3, figs. 9 *e;* 10, *d;* 11, *d;* Plate 6, fig. 28, *d.*)

sigpít. The two strips of bamboo that keep the cogon grass of an *agsít* in place, near the lower part of the grass (upper part of the *agsít*). They run across both sides of the *agsít* and are tied together at regular intervals. Cf. *puñgán.* (See Plate 6, fig. 27, *d.*)

The same name is applied to any couple of strips of bamboo that run across a wall or layer of *taléb,* one on each side. *Sigpít* also means "taking hold of, as with tongs."

síkañg. Cf. *bekkér.*

silíd. Room, sleeping room. A perfect Iloko house has one or more *silíd* separated from the sitting room, *teñgñgá* or *sálas,* by one or more partitions. Both the *teñgñgá* and the *silíd* form the *laém.* (See Plate 2, fig. 8, *a″.*)

(pag)silpo(án). Cf. *(pag)sañgál(an).* *Silpó* means "uniting."

síñgit. Any of the posts of a granary and any of the supplementary posts of a house. They are generally planted in the ground and reach only the floor. The *síñgit* of a house are used to support *busóran* girders, *patapáya* and *lipít,* etc. They are either flat at the top or jointed to the piece of timber they support in the same way as the *bayábay* are jointed to the tiebeams; sometimes, however, when they support two pieces of timber running parallel to one another, they may be jointed to them by a double *parañgáw,* cut out on opposite sides of the *síñgit.* The *síñgit* of a granary support the *paransúgay,* and mortises are cut in them to receive the tenons of the *batáñgan.* (See Plate 3, fig. 12, *e;* Plate 7, fig. 33.)

sírok. The space under the house, between the ground and the floor.

sóba. Either of the two triangular sloping ends of the roof, in houses of the *pinag-óñg* type (hip roof). A *sóba* extends from one of the *sekkég* tiebeams to the ridge of the roof. Cf. *ólo* and *bayakán.* (See Plate 3, fig. 10, *j.*)

sokdíp. Any thatch used to mend a leaking roof.

sokóg. Frame or skeleton of the roof. This term excludes the *atép* or roofing. Cf. *ólo.*

(pag)sokog(án). Arch mold of a window or doorway. *Sokóg* means "molding;" the combination *pag- . . . an* is a locative.

solókan. Any of the four rafters that connect a *dógo* or corner post with the ridgepole; in a hip roof: the hip rafter. (See Plate 1, fig. 1, *e;* Plate 3, figs. 9, *d;* 10, *l;* 11, *e;* Plate 6, fig. 28, *f.*)

sopí. Room, sleeping room. This name is applied to the *silíd* of small houses.

súli. Corner, angle.

(pa)súli. Any triangular piece of timber, which takes the place of the *pokló* or angle brace in some Iloko houses, a kind of angle block. The *pasúli* fills the corner, while the *pokló* does not. *Súli* means "corner;" the prefix is an instrumental.

súray. Prop or stay. Any piece of timber or heavy bamboo resting at one end on the ground and at the other against a post, a wall, etc., to prevent the latter from falling or leaning.

(pa)sursúr. Any bundle of thatch that covers the ridging at regular intervals. The leaves, etc., of the *pasursúr* run in the same direction as those of the ridging, and

serve as a supplementary cover for the several spots where the ridging is tied to the beams of the ridge. *Sursúr* means "going from place to place;" the prefix is an instrumental.

(ka)suúr(an). The part of the roof which is situated immediately over the hearth, and which is consequently covered with soot. *Súur* means "smoking;" the combination *ka . . . an* is a locative.

(pa)taguáb. Appentice or penthouse, a lean-to roof which is a direct continuation of one of the slopes of a complete roof, as one sheltering a staircase, a balcony, etc. Cf. *duág.*

talákib. Roof of bamboo. This term includes only the roofing. The layers of light bamboo (*taléb*) are placed in exactly the same way as the *agsít* of nipa leaves or of cogon grass.

talañgkúb. Sill, head. The *talañgkúb* is a section of bamboo split into two, and two *talañgkúb* form respectively the upper part and the lower part of a window frame, in houses that have shutters made of bamboo. Cf. *balló-loñg* and *paladpád.* (See Plate 1, fig. 3, *a, b.*)

The same name is applied to any of the two bamboos that run all along and over the ridging, one at each side, in order to prevent the latter from being blown off by the wind.

taléb. The *taléb* is a layer of bamboo made of sections of light bamboo split into halves and facing one another with the concave side, in such a way as to show nothing but the convex part on both sides of the layer. Consequently, each split bamboo fits half in one opposite split bamboo and half in the next one. To keep the bamboos in place, two notches are generally made at some distance from at least one of their ends (generally the upper one), one notch at each edge, and a strip of heavy bamboo runs between both opposite split bamboos, at the height of the notches; to that strip the split bamboos are tied with strips of rattan. Where no notches are made, ordinary *sigpít* keep the bamboos in place. The *taléb* is much used for walling purposes (for outer walls, rarely for partitions), and *taléb* roofing (*talákib*) may be seen in increasing quantities. (See Plate 7, figs. 34, 35.)

(pa)tapáya. The outermost of the two beams that run parallel with the tiebeams (*awanán* or *sekkég*), the *baríkes,* etc., and connect one *dógo* or corner post with the other, at the height of the floor. The innermost of the two beams is called *lipít.* The *patapáya* serve as supports for the walling. *Tapáya* means "supporting on the palm of the hand;" the prefix is an instrumental. (See Plate 2, fig. 7, *d;* Plate 3, fig. 9, *h;* Plate 5, fig. 22, *d.*)

táwa. Window.

teñgñgá. Sitting room. In some Iloko houses the *teñgñgá* covers the whole space of the *laém,* but in a perfect Iloko house one or more rooms (*silíd* or *sopí*) are separated from the *teñgñgá* by one or more partitions. This term has now very generally been abandoned for the Spanish term *sala,* which, however, is always used in its plural form, *salas,* the singular being used only to mean "dance." So also *silíd* is often superseded by *kuárto* (Spanish: *cuarto*). The term *baláy* is sometimes applied to the *teñgñgá,* and it is probably the original name,

at a time when the whole house had only one room, as is the case with the generality of the houses of the so-called non-Christian tribes. *Teñgñgá* means "middle." (See Plate 2, fig. 8, *a'*.)

tidtíd. Close-woven bamboo, as opposed to *minatá*, whether twilled (*binakúl*) or checker (*sinará*). *Tidtíd* is used extensively for walling (outer walls and partitions) and flooring (*daplát*) purposes. It is generally twilled, and the checker variety occurs rather rarely, for example: in a few partitions, etc. To prepare the bamboos (light ones, of course) destined to be woven into sheets, their outer surface is first cleaned, and then they are cut into halves; after which several cuts are made lengthwise at the internodes of each half bamboo, so as to render the flattening easy; then the inner surface is cleaned, and the bamboo is ready to be woven into sheets, either *binakúl* or *sinará*. (See Plate 1, figs. 2, 3; Plate 6, fig. 26, *g*.)

tóbag. The middle rafter of the *sóba* or triangular sloping end of a hip roof. This is the only rafter of the *sóba* that extends to the ridgepole. (See Plate 3, fig. 10, *i*.)

tókal. A prop, generally a section of bamboo, used to keep open a window shutter, made of bamboo, and hanging loose from an *alotoótan*, without being able to slide over it sideways. The lower end of the *tókal* rests on the *talañgkúb* or window sill, and the upper end pushes the lower part of the shutter outward and upward, until the latter reaches a slanting position.

(pa)tokbób. King-post. *Tokbób* means "pushing up (from beneath);" the prefix is an instrumental. (See Plate 3, fig. 9, *c*.)

toñgkál. Cf. *tókal.*

t(in)úbeñg. A house with a gable roof. Both sides of the roof (*bayakán*) are sloping, and it forms a gable (*bayañgbáyañg*) at each end. There are no *sóba* in the roof of the *tinúbeñg*. Cf. *p(in)-ag-óñg*. (See Plate 3, fig. 9.)

tukád. Rung, rundle, round, or step (of a ladder); step (of a staircase). Cf. *agdán*. (See Plate 5, fig. 21, *c*.)

tulbék. Key.

tul-óñg. Mortise. Cf. (*pa*)*rañg-áw*.

The same name is applied to the two heavy bamboos that are placed between the *sallabáwan* and the *pakabáyo* of the *boboñgán* or ridge of the roof. In this case the four of them are tied together and form the *boboñgán*.

(pa)tupék. The extremity of any part of the floor (whether timber or bamboo, whether lath, beam, or board, whether of the *dellég*, of the *básar*, or of the *datár*), which has been cut out into a more or less wedgelike shape, in order to give room to a post or *adígi*. Consequently the *patupék* surround the whole post, except the side (or two sides in a *dógo*) that faces the wall, where the *patapáya* is fastened to it. *Tupék* means "besetting, confining;" the prefix is an instrumental.

THE ILOKO CART

bakkóko. Rib, any of the curved strips or laths of bamboo, forming the principal part of the framework of the *balawbáw*.

balawbáw. Tilt, awning, canopy, covering. The most common *balawbáw* consist of three layers: an interior one, the *pasaplák*,

made of *minatá* (see the Iloko House) or open-worked woven bamboo; a central one, made of nipa leaves; and an exterior one, the *pandág*, similar to the first.

bañgkáy. Body or box (of a cart, of a sledge). Its bottom (*kadsaáran*) is rectangular, and its sides (*didíñg*) are straight and perpendicular to the bottom. An Iloko cart has the general appearance of an ordinary dump cart. *Bañgkáy* also means "dead body of a person;" originally: "the beheaded body."

bekkér. Cf. *burayóñgan.*

burayóñgan. The wooden axle or axletree of a *palakapák* or springless cart; it revolves with the wheels. The axle of a cart furnished with springs is usually called by its Spanish name: *eje.*

(pa)dapán. Runner (of a sledge). The same name is applied to the clawlike part of a sewing machine, through which the needle passes up and down. *Dapán* means "sole of the foot;" the prefix is an instrumental.

(ka)dsaár(an). Bottom (of a cart), bed (of a sledge). That part of a vehicle on which the load is placed. Cf. the same term under the Iloko House.

didíñg. Side (of a cart, of a sledge). The four sides of the *bañgkáy.* Cf. the same term under the Iloko House.

(ga)gan-áy(an). Either of the two heavy bamboos that run along and cover the *ñgárab* or upper border of both ends, in front and at the back, of the *bañgkáy* or body of a cart.

The same name is applied to a warping device and to a constellation. *Gan-áy* means "warping;" the suffix is a locative; the reduplication emphasizes the meaning. Cf. *luñggáñgan.*

guyúd(an). The rope or ropes attached to the fore end of a sledge, a plow, etc., and used to pull the latter. *Gúyud* means "pulling;" the suffix is a locative. Cf. *talí* and *kalombída.*

íkiñg. Either of the two edges of the *ñgárab* or upper border of the *bañgkáy* or body of a cart.

kalasíkas. The iron tire or rim of a wheel.

kalláwit. Hook.

kalombída. The rope with which the yoke is fastened to the shaft of a cart.

kasiñggáy. A small piece of wood or bamboo placed transversely over or against the two parts of a repaired shaft, pole, etc. When the shaft of a cart, for example, is broken, the Iloko place a similar piece of bamboo longitudinally against the remaining stump, in such a way as to double the shaft for a certain length, at the joint; then they place the *kasiñggáy* over or against both bamboos, the old stump and the new addition, and finally tie the whole outfit together with rattan. (See Plate 7, fig. 36, *a.*)

kuríbut. A receptacle for the lamp, the *báñga* or cooking pot, the ladle, etc. It is generally made of woven bamboo, and hangs somewhere at the *didíñg* of the cart, at the outside.

l(in)áñgub. Cf. *balawbáw.*

(pa)likúd. The back end of the *bañgkáy* or body of a cart, namely: that part of the *didíñg* which is detached when the contents of the cart are dumped. *Likúd* means "back, behind;" the prefix is an instrumental.

línoñg. Cf. *balawbáw. Línoñg* also means "shade."

lúgan. Vehicle. A general term, applied also to small boats. Most all vehicles used by the Iloko on

land, except the *palakapák*, the *pasagád*, and the *ulnás*, are known only by their Spanish names. In the following list, the vowels retain their Spanish pronunciation:

bagón. Wagon. From the Spanish *vagón.*

bisikléta. Bicycle. From the Spanish *bicicleta.*

ferokaríl. Railroad. From the Spanish *ferrocarril.*
the back. From the Span-

kalésa. A kind of two-wheeled calash, opening at the back. From the Spanish *calesa.*

karesón. Cf. *karetón.*

karetéla. A kind of dogcart. From the Spanish *carretela,* a kind of calash.

karetón. A kind of dump cart. From the Spanish *carretón.*

karomáta. A kind of two-wheeled chaise. From the Spanish *carromata,* which rather represents the Iloko *karetéla.*

kárro. A four-wheeled vehicle without body, either tilted or not, used for floats, for carrying coffins, etc. From the Spanish *carro,* cart.

kótce. Railroad car, automobile. From the Spanish *coche,* coach.

óto. Cf. *otomóbil.*

otomóbil. Automobile. From the Spanish *automovíl,* or the English *automobile.*

tren. Train. A Spanish term.

Half Spanish, half English:

motorsíklo. Motorcycle. In Spanish: *motocicleta.*

English:

trák. Bus. From the English *truck,* with identical pronunciation.

lun͠ggán͠gan. Either of the two heavy bamboos that run along and cover the *n͠gárab* or upper border of both sides of the *ban͠gkáy* or body of a cart. Cf. *(ga)ganáyan.*

n͠gárab. The upper border of the *ban͠gkáy* or body of a cart. The same name is applied to the rim or brim of a jar, a basin, etc.

n͠gípen. Tooth (of a harrow, a sugar mill, a bow net, etc.). *N͠gípen* also means "tooth (of men and animals)."

páko. Yoke. It consists of a piece of wood curved in the middle; both sides are tied to the shafts of the cart by means of ropes, called *kalombída.* The yoke simply rests on the neck of the animal, a carabao or a cow, without further attachment.

palakapák. Springless cart. A *karetón* without springs. The typical Iloko cart described in this paper. A spring is called *muélie,* from the Spanish *muelle.*

palaopó. Nave or hub (of a wheel).

pallatíwan. Either of the two thills or shafts, between which the animal is hitched.

pandág. The exterior layer of the *balawbáw.* It covers the nipa leaves and consists of open-worked woven bamboo or *minatá.* Cf. the same term under the Iloko House.

pannúbek. Any of the four vertical pieces of timber or bamboo that connect the runners of a sledge with its bed or body, at each corner. Probably from the stem *súbek* or *túbek,* and the instrumental prefix *pan͠g,* changed into *pan* (*n* reduplicated here) through its combination with the initial letter of the stem.

(pa)pan͠gál(an). Step (of a vehicle).

The same name is applied to the hock of an animal.

pañggo(én). To drag, to haul (any heavy load, without the aid of any vehicle). This is done by one or more carabaos, cows, etc. From the stem *pañggó* and the suffix *en* of substantival verbs.

paragpág. Cf. *bakkóko.* *Paragpág* also means "rib (of men and animals)."

payát(an). Cf. (*pa*)*pañgálan.* *Páyat* means "treading upon;" the suffix is a locative.

pílid. Wheel, cart wheel. The typical Iloko cart wheel is solid and has no spokes. A spoke is called by its Spanish name *rayo*, generally in the plural: *rayos.* The fellies are called *sínta*, from the Spanish *cinta.*

s(in)ábeñg. A shutter used to close the *balawbáw*, at the back. It is sometimes provided with a small window.

(pa)sagád. Sled or sledge. It consists of a *bañgkáy*, which, by means of four *pannúbek* or posts, rests on *padapán* or runners, instead of on *pílid* or wheels. It has no *pallatíwan* or thills, but is pulled by means of a rope, called *guyúdan.* The *balawbáw* is generally absent. *Sagád* means "harrow;" the prefix is an instrumental. Cf. *ulnás.*

sagpát. A contrivance of woven bamboo, generally suspended from the *balawbáw*, at the inside, towards the back. It is used as a receptacle for pillows, blankets, clothes, etc. *Sagpát* also means "ascending slope."

sañgól. Cf. *páko.*

(pa)sapläk. The interior layer of the *balawbáw;* it is covered by the nipa leaves and consists of openworked woven bamboo or *minatá.* Cf. the same term under the Iloko House.

talí. Rope. The reins are called *rienda*, a Spanish term. Cf. *guyúdan* and *kalombída.*

tambúbuñg. Cf. *balawbáw.*

tugáw. Seat; box (of the driver).

ulnás. Sled or sledge. The *ulnás* has no *bañgkáy*, it consists of a simple bed resting on runners, by means of four *pannúbek.* For the rest it is identical with the *pasagád.*

ILLUSTRATIONS

Plate 1

FIG. 1. Tiebeams and rafters; *a, awanán; b, sekkég; c, bekkér; d, sallabáwan; e, solókan; f, pasañggír.*

2. Shutter seen from outside; *a, awanán; b, dógo; c, rikép ti táwa; d, baútek; e, balatbát; f, alotoótan; g, alintúboñg.*

3. Shutter seen from inside; *a, talañgkúb* applied to *ballóloñg; b, talañgkúb* applied to *paladpád; c, balunét.*

Plate 2

FIG. 4. Fence with gate; *a, bañgén.*

5. Bar closing window; *a, bañgkíl.*

6. Clamp; *a, bañgkíl.*

7. Principal beams of wall; *a, dógo; b, awanán* or *sekkég; c, baríkes; d, patapáya.*

8. Floor plan of a house; *a, kadaklán* or *laém; a', teñgñgá; a'', silíd; b, batalán; c,* kitchen; *d, bañgsál.*

Plate 3

FIG. 9. House with gable roof; *a, dógo; b, bayábay; c, patokbób; d, solókan; e, sekkég; f, awanán; g, baríkes; h, patapáya; i, pasañggír; j, sallabáwan; k, bayakán; l, bayañgbáyañg.*

10. Hip roof; *a, parákit; b,* removed *solókan* showing *c; c,* tenon of *dógo; d, sekkég; e, pasañggír; f, parbó; g, sallabáwan; h, pakikít; i, tóbag; j, sóba; k, bayakán; l, solókan; m, sagumaymáy; n, awanán.*

11. Gable roof; *a,* tenon of *dógo; b, bayakán; c, awanán; d, sekkég; e, solókan; f, pasañggír; g, sallabáwan.*

12. Granary; *a, paransúgay; b, kádañg; c, awanán; d, batáñgan; e, síñgit.*

Plate 4

FIG. 13. Ridge of a roof; *a, sallabáwan; b, pakabáyo; c, pasañggír.*

FIGS. 14 to 17. Ornaments.

FIG. 18. Rafter and tiebeam; *a, pasañggír; b, awanán* or *sekkég; c, pakokó.*

19. Window sash; *a, kulintípay.*

20. Rafters; *a,* tiebeam or pole plate; *b, sagumaymáy; c, pasañggír; d, ladét.*

Plate 5

FIG. 21. Removed ladder; *a, baútek; b, agdán; c, tukád; d, liliktádan; e, patapáya; f. adígi; g, roáñgan.*

22. Lower beams of wall; *a, dógo; b, bayábay; c, lipít; d, patapáya.*

23. Openwork woven bamboo (twilled).

24. Openwork woven bamboo (checker).

PLATE 6

FIG. 25. Pigsty.

26. Flooring; *a, lipít; b, busóran; c, dellég; d, pañgarásan; e, básar; f, akílis; g, daplát.*

27. Thatch; *a, agsít; b, payák; c, puñgán; d, sigpít.*

28. Braces; *a, pokló* or *sakóbo; b, pokló; c, awanán; d, sekkég; e, sallabáwan; f, solókan; g, pasañggír.*

PLATE 7

FIG. 29. Scarf joint; *a, sánat.*

30. Mortise and tenon of a *bayábay* post; *a, parañgáw.*

31. Mortise and tenons of *bayábay* post; *a, parañgáw.*

32. Mortises and tenon of a *dógo* post; *a, parañgáw.*

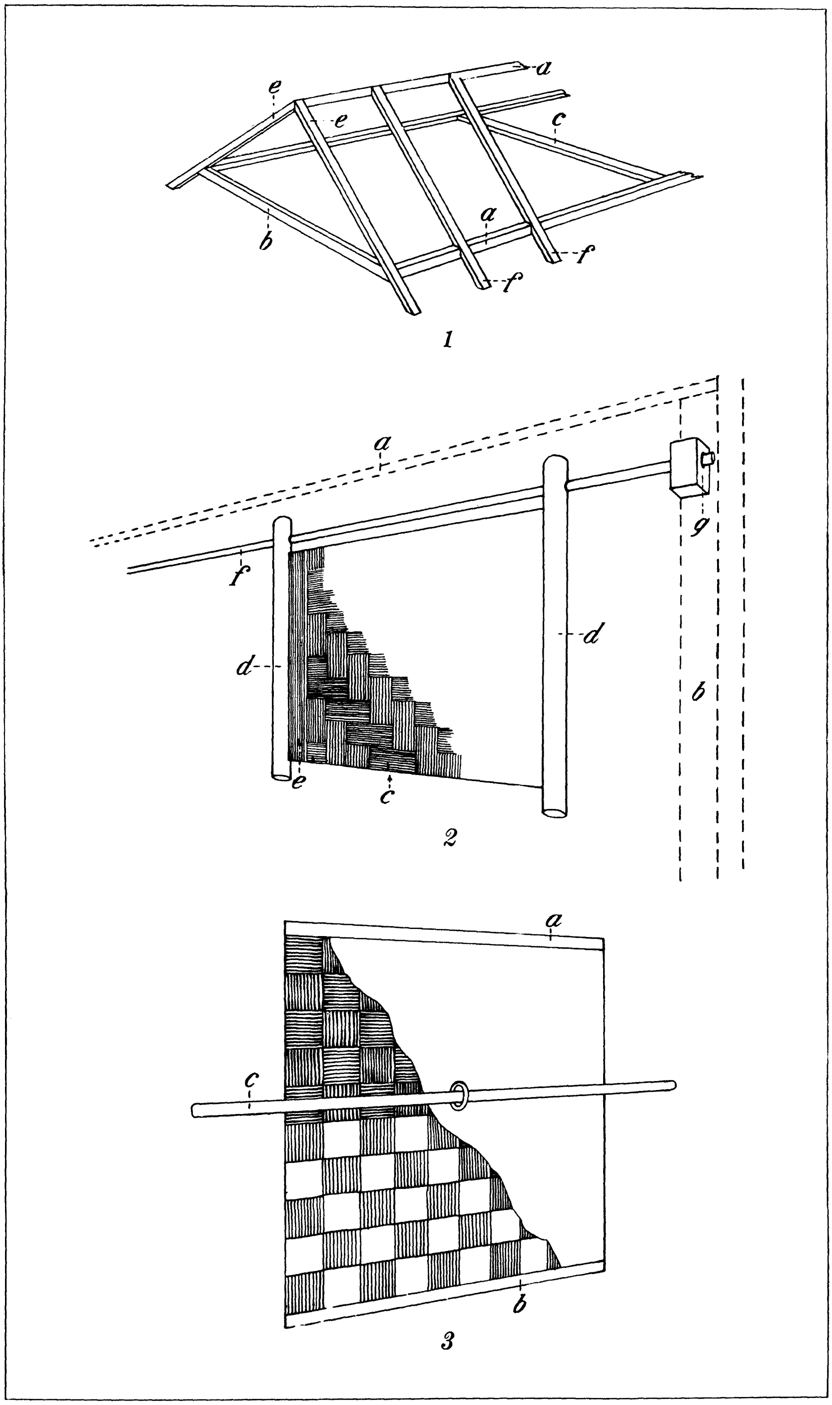
33. Mortises and tenon of a *síñgit* post; *a, parañgáw.*

34. Walling.

35. Bamboo of walling.

36. Repaired shaft; *a, kasiñggáy; b,* broken *pallatíwan.*

PLATE 8. AN ILOKO HOUSE



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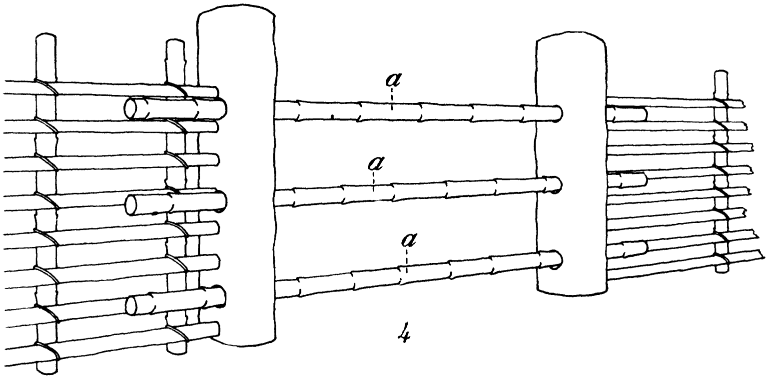

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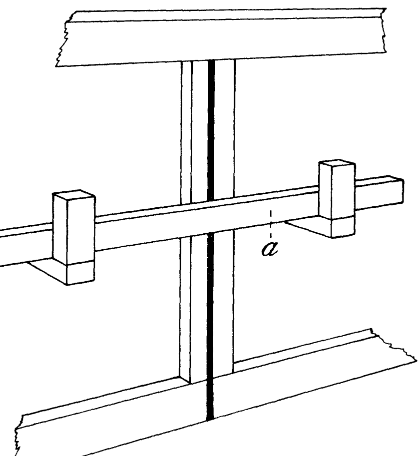

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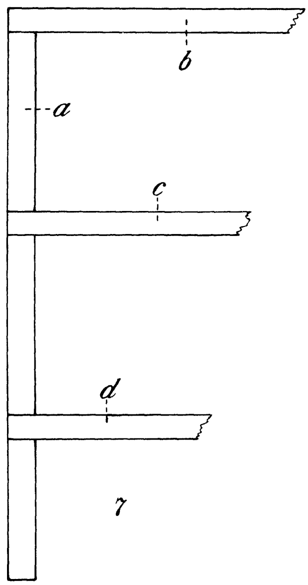

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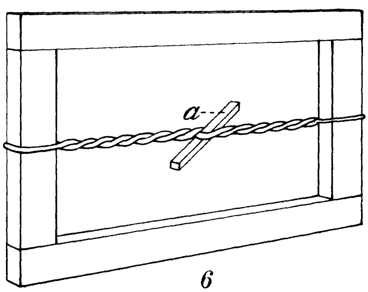

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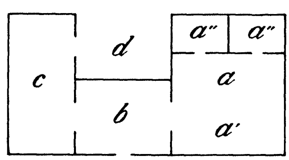

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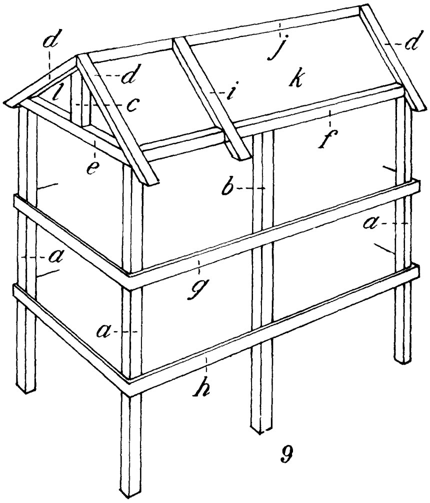

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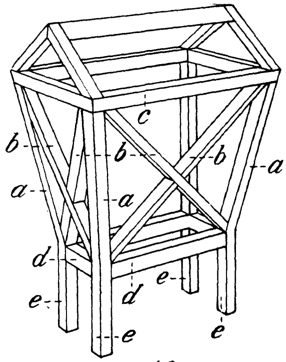

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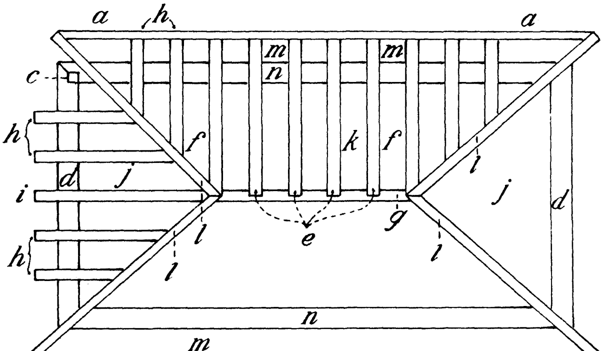

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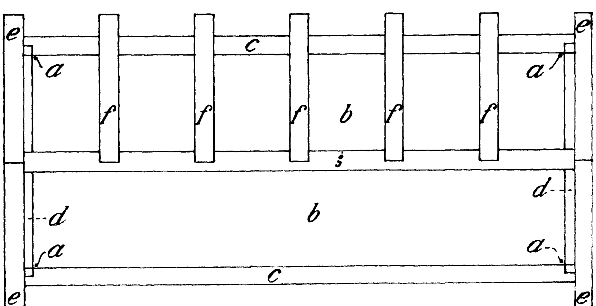

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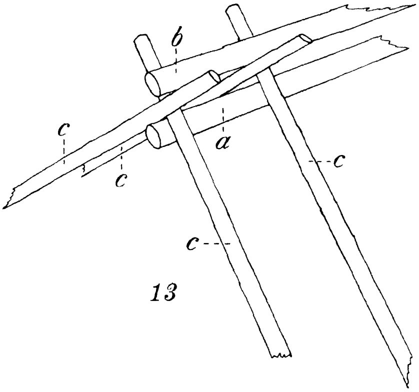

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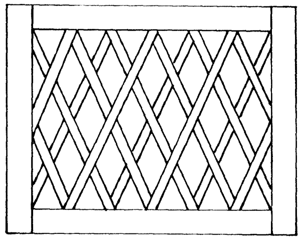

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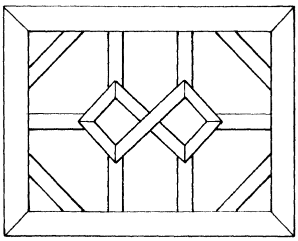

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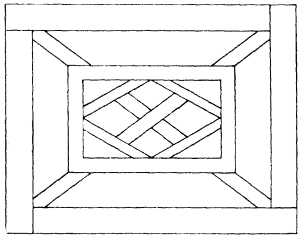

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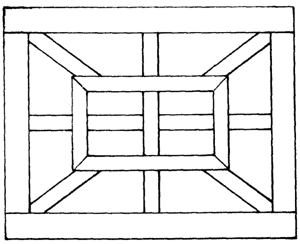

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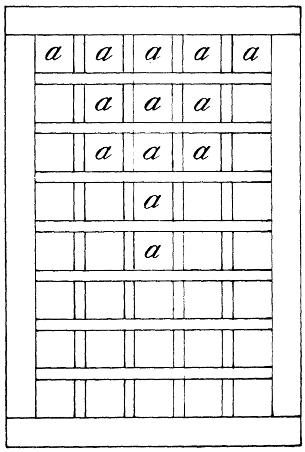

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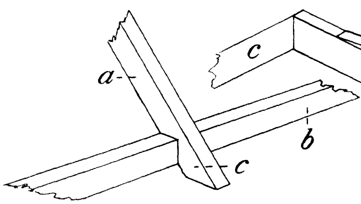

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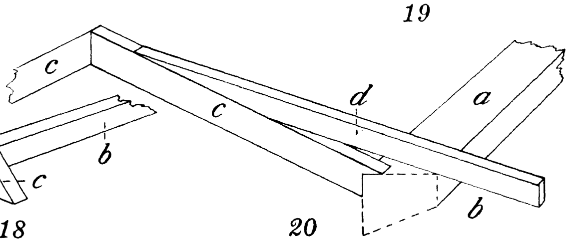

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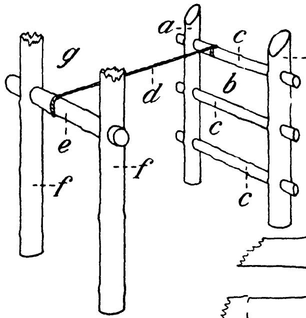

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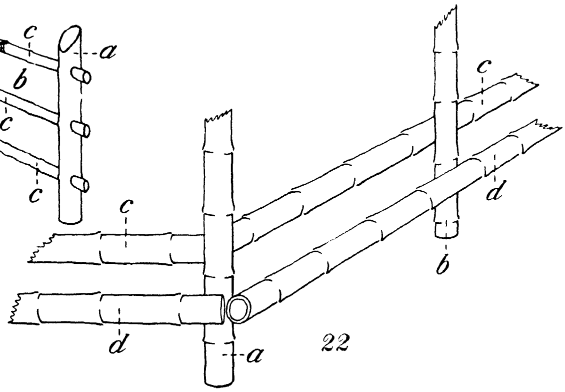

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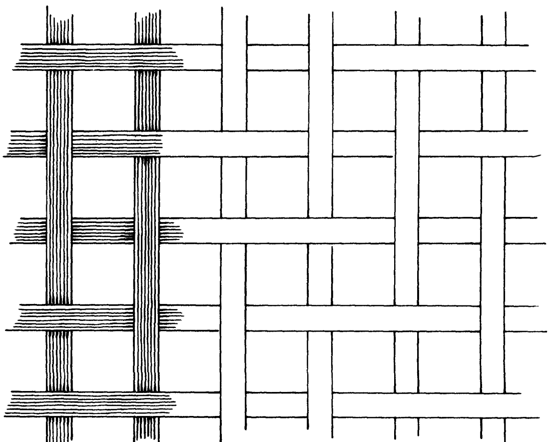

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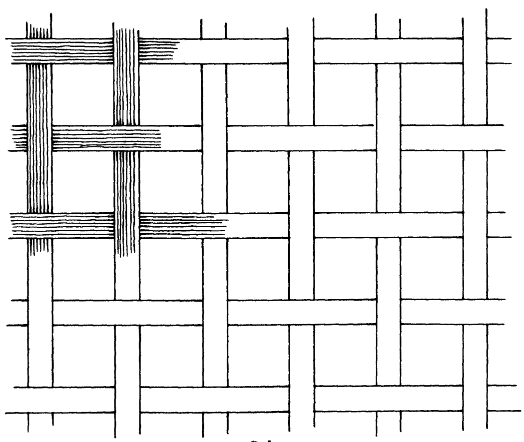

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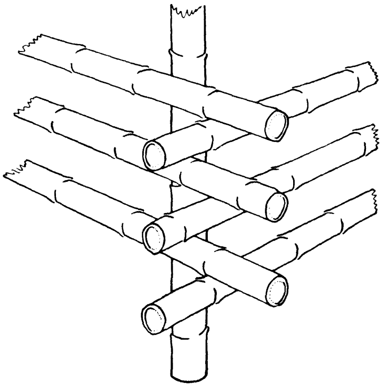
PLATE 5.



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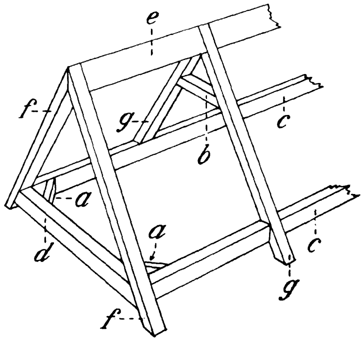

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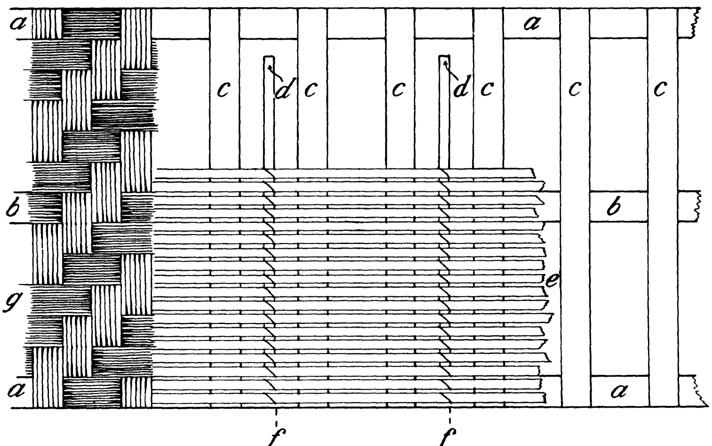

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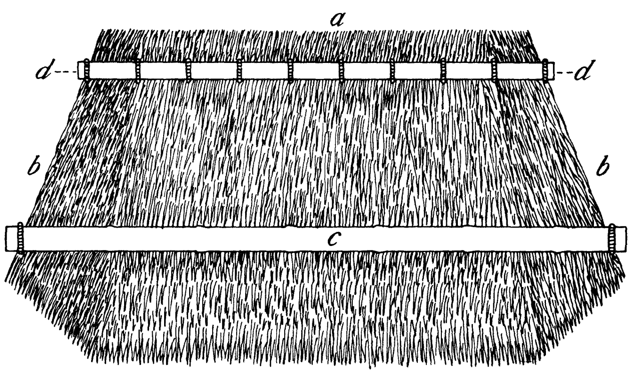

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PLATE 6.

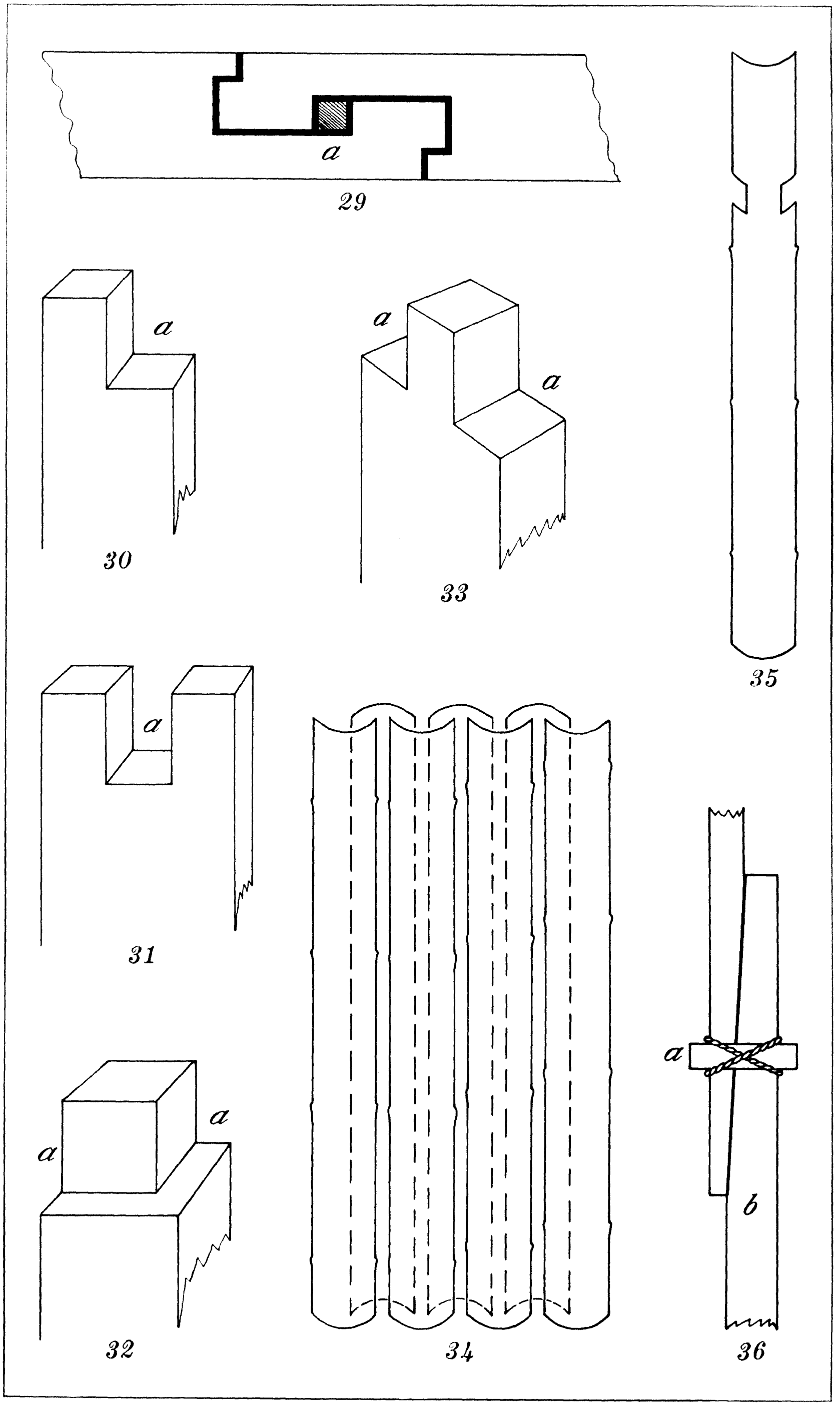

PLATE 7.

PLATE 8.

THE NUTRITIVE VALUE AND COST OF THE PHILIPPINE CONSTABULARY RATION [1]

By ISABELO CONCEPCION

Of the Section of Nutrition, National Research Council of the Philippine Islands; and the Department of Physiology and Biochemistry College of Medicine, University of the Philippines
Manila

The proper feeding of an army presents many considerations. The most important is the available food supply. Other important problems are presented by storage, prevention of spoilage, and the preparation of food. It is the duty of those who are responsible for the feeding of the troops to maintain such a balance of the essential food elements as will safeguard health and increase vigor. The relative proportions of proteins, fats, and carbohydrates, the amount of mineral salts, and the so-called vitamins must be considered. A certain amount of roughage is also necessary to promote regular intestinal movements.

Food is generally measured in calories. Energy is supplied in the form of fats, proteins, and carbohydrates. The proportions of fats and carbohydrates in the diet are as a rule immaterial, if enough energy is furnished to meet the demand of the organism; proteins, on the other hand, are necessary for the growth and repair of body tissues. If the diet does not furnish enough protein, growth is stunted and an inferior individual is produced.

While the mineral salts are not sources of energy, they are just as necessary as are proteins, carbohydrates, and fats. They are, in fact, indispensable to growth and proper nutrition. The human body is constantly losing minerals, and this loss must be replaced through diet; otherwise good health cannot be maintained. The current belief that a diet satisfactory in all other respects will contain the necessary minerals in sufficient quantities is not supported by fact. An adult individual whose tissues are fully formed need replace only the minerals that are

[1] The expenses of this investigation were defrayed by a special grant furnished by the National Research Council of the Philippine Islands.

continually excreted. Children, however, require additional proteins as a "growth quota" to insure the proper growth of the skeleton. There is evidence that mineral elements have other functions in growth that are not so well understood. The effect upon the development of bones of a diet deficient in mineral salts is well known; the degree to which growth and gain in weight are influenced by the mineral salts in the diet is not so generally appreciated.

Besides the energy-yielding foods and the minerals, the substances called vitamins have very specific properties for promoting growth and health. Vitamins are indispensable constituents of an adequate diet. In the words of Professor Sherman (1925), "All nutrition work, to be worthy of our knowledge and opportunity, must stand four square upon equal recognition of calories, protein, mineral elements, and vitamins." Although the vitamins are known to be essential for growth and health, it is not possible to include them in an analysis, because not all of them can be measured quantitatively. The relative value of many foods as sources of vitamins is now fairly well established through animal experimentation. In judging, however, the adequacy of the vitamin in man's diet, the best that can be done at present is to see how liberally the foods that are especially good sources of the various vitamins are included.

Under ordinary conditions of life people select their food according to their taste and appetite. Due to the instinct of self-preservation the selections are sufficiently varied to result in an adequately balanced diet. In the case of an army, however, the men do not choose their food. The food is placed before them in the mess, and they may eat it or leave it. It is, therefore, of the utmost importance that the food supplied to them be wisely selected and prepared so as to preserve or increase its nutritious and appetizing qualities. Hence, frequent changes of menu are desirable and necessary.

The object of the present investigation is to study the adequacy of the food given to the Philippine Constabulary soldiers and to compare it with the food given to soldiers in other countries.

REVIEW OF PREVIOUS LITERATURE

The information available about army rations in this country is very meager. The first comprehensive study was made by Chamberlain (1911) in connection with his study of beriberi among the Philippine Scouts.

PLAN OF THE WORK AND SOURCES OF DATA

The present survey was undertaken at the Manila Garrison, in Gagalangin, about 2.5 kilometers from Manila; and at Camp Murphy, in Cubao, Mariquina, about 7.5 kilometers from Manila. The food given to the 729 men at these camps for one week has been studied quantitatively.

A detailed account was made of all food materials purchased each day, and of those obtained from the camp stock, such as rice, canned goods, cocoa, coffee, etc. The actual weight and cost of each item brought from the market or taken from the stock were carefully noted. In addition, all kitchen and table waste and all left-overs were collected and weighed. The weight of these was subtracted from the total weight as purchased. The difference represented the actual amount of food consumed. From the amount thus obtained, calculation of the nutritive value of the food intake was made by the method elaborated by E. Hawley (1929), which provides for the calculation of the energy, protein, calcium, phosphorus, and iron in the diet, and is designed for food as purchased. The food materials not given in the table of Hawley were not included in our short-cut method, but are evaluated separately according to the tables of composition prepared by Hermano (1932), Santos and Adriano (1929), Valenzuela (1928), Adriano and de Guzman (1931), Marañon (1935), and Sherman (1927).

RESULTS

The results of the survey are summarized in Tables 1 to 6.

TABLE 1.—*Per capita intake of food by the Constabulary soldiers during one week at the Manila Garrison and Camp Murphy.*

Average weight of soldier, kg	55.3
Calories:	
Total	3,731.21
Per kg of body weight	67.47
Protein:	
Total	116.9
Per kg of body weight	2.11
Calcium, g	0.347
Phosphorus, g	1.23
Iron, g	0.015

TABLE 2.—*Total calories, total protein intake, cost per capita per day, and cost per 1,000 calories of food taken.*

Total calories	3,731.21
Protein, g	116.9
Cost per capita per day, centavos	27.2
Cost per 1,000 calories, centavos	7.3

TABLE 3.—*Distribution of food intake in percentage of total calories.*

	Percent of total calories.
Cereals and grains	67.94
Milk and dairy products	2.3
Vegetables and fruits	7.4
Fats and oils	4.6
Sugar and sweets	6.8
Meat, fish, eggs, etc.	10.4
Miscellaneous	0.56

TABLE 4.—*Distribution of proteins according to sources.*

Vegetable protein in per cent of total protein	64.1
Animal protein in per cent of total protein	35.9

TABLE 5.—*Distribution of expenses of different food groups in percentage of the total cost.*

Cost per capita per day, centavos	27.2
Cereals and grains, per cent	36.9
Milk and dairy products, per cent	3.6
Vegetables and fruits, per cent	13.3
Fats and oil, per cent	1.4
Sugar and sweets, per cent	5.4
Meat, fish, eggs, etc., per cent	37.4
Miscellaneous, per cent	2.0

TABLE 6.—*Number, age, height, and weight of men studied.*

Men studied	729
Average age, years	23.13
Average weight, kg	55.3
Average height, cm	164.48

ENERGY REQUIREMENT OF THE SOLDIER

The amount of heat necessary to meet the daily demand of our bodies, even during rest, is supplied by the food we eat each day. In approaching the question of energy requirement one must bear in mind that energy expenditure is influenced by several factors—age, sex, race, occupation, muscular activity, etc. In estimating the amount of energy expended by the body, there are four main factors to be considered: The basal metabolism; maintenance of body temperature; the increase of metabolism due to the specific dynamic action of the food; and muscular activity.

The determination of the amount of work done by the soldier is divided into two parts: The amount of work done during the

training period; the amount of work done during action. Since the training period is approximately uniform, and since the conditions are most favorable for the determination of the energy expenditure, more was learned concerning this phase than concerning actual fighting conditions. During action the amount of energy expended varies more or less with the individual, and the exact amount cannot be measured because of the urgency of the situation.

Lusk has calculated for American soldiers that 4,000 calories are sufficient to maintain body weight and to supply the necessary energy for a seasoned soldier weighing 70 kilograms (154 pounds), and carrying a pack weighing 44 pounds, to make a forced march of 30 miles in ten hours. Rockwood (1925) gives the following figures for the United States soldiers whose average weight is only 146 pounds:

TABLE 7.—*Calories expended.*

	Calories.[a]	Corrected calories.	
		For Americans.[a]	For Filipinos.[b]
Basal metabolism	1,767	1,695	1,494
Energy standing	118	113	106
Walking 10 hours, 3 miles per hour	1,705	1,606	1,532
Walking with pack, 20 kg.	484	484	348

[a] Figures taken from Rockwood.
[b] Calculation by the present author based upon the height and weight of Philippine Constabulary soldiers from the estimates given by Lusk.

Comparison of the average caloric intake of the Philippine Constabulary soldiers with the average food consumption of the United States Army in the training camp, as given by Murlin and Hildebrandt (1919), shows that the average food consumption of our soldiers compared favorably with the American. The above authors found in their investigation in 427 messes an average of 58.7 calories per kg body weight, while my findings on the Philippine Constabulary soldier were 67.47 calories per kg body weight. Compared with the average caloric value of the basal ration of the Philippine Scouts, the caloric value of the diet of the Constabulary is as good as the American, if not better, as shown in Table 8.

TABLE 8.—*The per capita food intake of the Constabulary soldier, United States Army Training Camps, and Philippine Scouts.*

Organization.	Average weight.	Calories.		Protein.	
		Total.	Per kg.	Total.	Per kg.
	kg.				
Philippine Constabulary	55.3	3,731.21	67.47	116.9	2.11
United States Army Training Camps.	66.4	3,898.0	58.7	129.0	1.94
Philippine Scouts	55.0	3,672.0	66.7	----------	----------

These figures, of course, do not cover the entire amount of food consumed, since many of the soldiers in the camp supplemented their meals by buying food from the post exchange or stores around the camp. A study of the amount consumed by each soldier was not possible on account of the meager data available at the post exchange at the time of the survey.

PROTEIN REQUIREMENT

How much protein does an average Filipino soldier need? In the answer to this question three points must be considered in the light of present day knowledge, according to McLester (1927):

The quality or biologic value of the protein consumed;

The distinction between the minimum and the optimum as applied to protein intake;

The criteria by which "health and vigor" are judged, whether by a sense of well-being with efficient accomplishment of work experienced during limited periods or by the preservation of youthful vigor with comparative freedom from disease during an appreciable fraction of the person's life.

There is no agreement as to the amount of protein required in the diet. The point at issue is whether a high protein intake is preferable to a low protein intake, which such authorities as Chittenden and Hindhede have shown can be maintained for long periods without harm. More research is necessary to settle this controversial question.

During the World War an attempt was made to keep the protein components as high as possible in spite of the necessary food restrictions. This standard, according to Rockwood, may

be due to two causes: "(1) some of the men of the various armies were used to a high protein diet; and changing their food habits in war time would be one factor in lowering their morale; and (2) that a high protein diet adds to one's strength, endurance and vitality, which is one of the arguments, very difficult to prove, but often advanced, in favor of the higher protein value."

Table 8 shows that the average protein intake of the Philippine Constabulary soldier was 116.9 grams per day and 129 grams in the United States Army in training camps. Although at first glance the average intake of the Americans is greater than that of the Filipinos, in terms of protein per kilogram body weight the Filipinos have an average intake of 2.11 grams and the Americans 1.94 grams. Another thing to be taken into consideration is the distribution of protein according to sources. Table 4 shows that 64.1 per cent of the total protein is derived from vegetables and only 35.9 per cent is derived from animals. This figure is rather low compared with that of the animal protein consumed by the Americans.

THE DISTRIBUTION OF FOOD CONSTITUENTS IN THE DIET OF THE PHILIPPINE CONSTABULARY

In studying the nutritive value of a given diet, very little attention is paid to the proportions of its protein, fat, and carbohydrate. The correct amount of fat and carbohydrate in a given diet is difficult to determine. The investigations of Krogh and Lindhard (1920) showed that there is an appreciable loss of energy in working on a fat diet. They found that the waste of energy from fat was 11 per cent of the heat of combustion of fat. In the ordinary mixed diet, which contains a large amount of carbohydrates, the amount of waste on this basis was quiet small. Another reason why a high fat diet is not desirable is its high cost, since fat comes largely from animal sources, and is therefore more expensive than the grain products that furnish the bulk of the carbohydrates in our diet. It seems that the relative amount of fat and carbohydrate necessary in the ordinary diet depends more on economic factors and individual taste than on nutritional requirement.

TABLE 9.—*Constabulary ration compared with the ration of the different allied armies.*[a]

Organization.	Protein.	Fat.	Carbohydrates.	Calories.			
				Total calories.	Protein.	Fat.	Carbohydrates.
	g.	*g.*	*g.*		*Per cent.*	*Per cent.*	*Per cent.*
Philippine Constabulary	116.9	94.23	579.41	3,731.21	12.85	23.49	63.66
British Home Ration, May, 1918.	124.0	136.0	419.0	3,483.0	14.6	36.4	49.0
Canadian, July, 1918	107.0	118.0	344.0	2,946.0	14.9	37.2	47.0
French Normal, March 29, 1918.	138.0	98.0	467.0	3,604.0	15.7	25.3	59.0
Italian Territorial, February, 1917.	127.0	38.0	469.0	2,797.0	18.6	12.6	68.8
United States Garrison, Ration A. R. 1221.	147.0	174.0	643.0	4,859.0	12.85	33.3	54.2
Consumed in United States Training Camps, 427 messes and canteen purchases.	129.0	136.0	545.0	3,898.0	13.0	31.0	56.0

[a] From Murlin and Hilderbrandt, Am. Journ. Physiol. 49 (1919) 531.

Table 9 shows that the percentage of protein intake of the Philippine Constabulary compares favorably with the United States garrison ration and in some respects with the mess ration of the United States Training Camps; but it is very much lower than that of the other armies of the world, especially the Italian. On the other hand, the percentage of fat compares favorably with that of the Italian Territorial Army but is very much inferior to that of the European and United States Armies. In percentage of carbohydrates, the Philippine Constabulary also compares favorably with the Italian army. These two armies are characterized by a high proportion of carbohydrates in their ration. Carbohydrates in the Italian army ration are 68.8 per cent of the total calories, and of the Philippine Constabulary, 63.6 per cent.

MINERAL REQUIREMENT

Mineral salts play an important rôle in an adequate diet. There are ten or more mineral elements needed by the body. Only three were included in this survey; namely, calcium, phosphorus, and iron. Calcium and phosphorus are essential for bone and tooth development. Iron is necessary for the formation of hæmoglobin. The human body is constantly losing minerals, and this loss must be replaced by proper diet; otherwise good health cannot be maintained.

Table 10 shows the average amount of calcium, phosphorus, and iron intake.

TABLE 10.—*Mineral intake of Philippine Constabulary soldiers compared with the Sherman standard.*

	Calcium.		Phosphorus.		Iron.	
	Amount.	Percentage of standard.	Amount.	Percentage of standard.	Amount.	Percentage of standard.
	g.		*g.*		*g.*	
Standard (Sherman) of safety.	0.68	100	1.32	100	0.015	100
Philippine Constabulary	0.347	51	1.23	93	0.015	100
United States Army ration.[a]	0.711	104	2.17	164	0.029	194

[a] Blatherwick, N. R., Am. Journ. Physiol. 49 (1919) 567.

Table 10 shows that the calcium intake of the Philippine Constabulary soldier is only 51 per cent of the Sherman standard of safety. Although Sherman believes that 0.44 gram of calcium is sufficient to maintain the calcium balance in an adult individual—and this belief is corroborated by Santos (1935) in the case of women—he considers that the amount of calcium for safety should be 0.68 gram per day. It is evident, therefore, that the calcium intake of the Philippine Constabulary soldiers is not even sufficient to maintain calcium balance. The very limited use of milk and dairy products in the diet of the Filipino people and the insufficient intake of green, leafy vegetables result in this low calcium intake. In the case of adults there may be prolonged deficiency of calcium in the diet without the appearance of symptoms, because the losses from the blood and soft tissues may be replaced by calcium withdrawn from the bones. Bauer and his associates (1929) postulated a hypothesis that the bone trabeculæ may readily give up calcium to meet the needs of the body as a whole. If we add to this the effect of sunlight on the calcium of mobilization, it is not strange that, even with a low calcium intake, Filipinos do not show symptoms of calcium deficiency.

The phosphorus intake constitutes only 93 per cent of the Sherman standard. In the phosphorus-balance experiments carried out by Sherman he found that an average of 0.88 gram per 70 grams of body weight is sufficient to maintain phosphorus balance in an adult individual. The iron intake compares favorably with the Sherman standard.

PERCENTAGE DISTRIBUTION OF NUTRIENTS IN RELATION TO TOTAL CALORIES

Table 3, summarizing the percentage distribution of nutrients in relation to total calories, shows that one of the characteristics of the Oriental diet in contrast to the Occidental, is the predominance of grain products. The percentage distribution of grain products in the case of Philippine Constabulary soldiers is 67.94 per cent, compared with that of the low-cost American diet as given by Sherman, which is 37.79 per cent of the total calories. On the other hand the calories derived from milk and dairy products constitute only 2.3 per cent of the total calories as compared with 9.05 per cent of the low-cost American diet. The same thing can be said of fruits and vegetables; these comprise only 7.4 per cent in the case of the Philippine Constabulary, compared with 12.9 per cent in the low-cost American diet.

DISTRIBUTION OF EXPENSES

Although no satisfactory standard for the distribution of expenses for the various food groups can be given with certainty, because of the many factors involved; such as habits of the individual, availability, and market price; it was suggested by some authorities in nutrition in the United States (1919) that about one-fifth of the food budget be spent on each of the five groups: Meat, fish, and eggs; milk, cream, and cheese; fatty foods, sweets, and miscellaneous foods; cereals; fruits and vegetables. It is interesting to see how the results of the present survey vary from this standard. In Table 5 the distribution of expenses for the different food groups in percentage of the total cost is summarized. In that table the per capita cost per day for each soldier is only 27.2 centavos, and the average cost per hundred calories is 7.3 centavos per day. In the percentage distribution of expenses the most striking finding observed is that 37.4 per cent of the total expenses is alloted to meat, fish, and eggs, which is even higher than the amount expended on cereal and grains, which is only 36.9 per cent. The amount spent for meat and fish and for cereals and grain is more than double that of the above standard. On the other hand the amount spent for meat and dairy products is less than one-fifth of the amount recommended by the nutrition authorities, as shown in Table 11.

TABLE 11.—*Distribution of expenses in the different food groups compared with the well-known standards.*

Source of data.	Cereals and grain.	Milk and dairy products.	Vegetables and fruits.	Fats, sweets, and miscellaneous.	Meat, fish, eggs, etc.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Office of Home Economics	13	15	25	18	29
United States Department Agriculture Thrift Leaflet (1919).	20	20	20	20	20
Sherman standard of low-cost diet	12–15	27–33	15–18	10–15	10–15
Philippine Constabulary	36.9	3.6	13.3	8.8	37.4

PROTECTIVE FOODS IN THE DIET OF THE PHILIPPINE CONSTABULARY

Roxas (1922), in studying the protective foods in the diet of the students' mess at Los Baños, found that they constitute only 10.55 per cent of the diet. Concepcion's (1936) recent findings on the food intake of Filipino college students showed that they constitute only about 6 per cent of the total calories and 19 per cent in relation to the total cost. Sherman recommends that at least as much money be spent for milk and dairy products and for vegetables and fruits as is spent for meat, fish, and poultry. It is very difficult for Filipinos to follow this recommendation on account of the high cost of milk and the low standard of living of the general population. If Sherman's recommendation were followed there would be a deficiency in total calories, although the calcium and the protein content of the diet would be improved. An adequate milk intake in our daily diet is a vital factor in making up our calcium deficiency. Furthermore, milk is rich in vitamins A and D and contains also vitamins B_2 and C, not to mention the adequate protein it contains that will supplement the proteins found in rice. McCallum (1929), in discussing the characteristic attributes of the most satisfactory type of diet, states:

The first and the most important principle is the extension of the use of dairy products. Instead of the consumption of half a pint of milk a day, there should be about a quart per capita.

The second principle is that there are dietary properties in the leafy vegetables which are unique among foods of vegetables origin. These have been the "protective foods" for many of the Asiatic peoples.

A third principle of great importance in nutrition, viz., that of taking daily certain amount of raw vegetable food to provide a sufficient amount of the antiscorbutic substance. If these simple principles are adhered to,

the main features of an adequate diet will be fulfilled, and the remainder of the food supply may safely be derived from any of our ordinary milled cereal products, tubers, root vegetables, sugar, and meats.

VARIETY IN THE DIET

A study of the variety in the Constabulary diet showed that the average number of articles used in the mess was forty-nine. This is shown in Table 12. It has been estimated that the average American family uses thirty-nine articles each week, while the average Filipino family uses from twenty to thirty articles a week.

The menus given during the time of the survey are sufficiently varied as can be seen in Table 13. I have also included as Table 14 the fifteen days' menus, as proposed by the mess officer, from November 1 to 15, 1935.

SUMMARY AND RECOMMENDATIONS

1. The present ration given to the Philippine Constabulary soldiers is quite sufficient with regard to the total calories and protein but is very deficient in calcium. The proportions of protein, fat, and carbohydrates in the ration compare favorably with the well-known standards. The vitamin-carrying foods are not sufficient for a well-balanced diet.

2. In the distribution of expenses, the amount of money spent for meat, fish, and eggs is almost as large as the amount spent for grain products, which should not be the case. Although meat is one of the good sources of protein, it is poor in calcium and in vitamins. It may be suggested that meats other than those of the muscle type, such as kidney, liver, heart, sweetbreads, and brain, should be used more. They are superior in some respects to the muscle type of meats for they are rich in vitamins A and B, and their use would assist in varrying the diet. The use of pork meat should be more liberalized for it has been shown by Cowgill that it contains plenty of vitamin B_1. This would supplement the deficiency of this vitamin in polished rice which constitutes the bulk of the constabulary ration.

3. The milk in the ration is so small that it barely meets the requirement for use in coffee or cocoa. Milk is a rich source of all the known vitamins and is the only common article of

diet sufficiently rich in calcium to preserve the normal calcium-phosphorus balance. Additional allowance of milk, therefore, is strongly recommended to remedy the marked calcium deficiency in the present diet.

4. The use of fresh fruits should be extended. No fruit other than bananas was being served during the time of the survey. Fresh fruits are in general good sources of vitamins. They tend to preserve the alkali reserve of the blood and, therefore, are a valuable constituent of any balanced ration. Vitamins B and C are contained in appreciable amounts in practically all fruits. Tomatoes, oranges, lemons, and pomelo are excellent sources of the antiscorbutic vitamin C. The amount of fresh fruits in the present ration of the constabulary should be increased.

5. Fresh vegetables of the green leafy type are not given regularly in the diet, probably because of the ignorance of the good dietary properties or the high cost of some of the leafy vegetables in the market. However, there are leafy vegetables that can be procured quite economically, and their use should be encouraged. Pechay, Chinese mustard, alugbati, cabbage, pumpkin, kidney beans, camote leaves, and kangkong can be bought in the local markets at fairly moderate cost and their use should be encouraged. Potatoes and onions should be used more extensively than they are at present. The potato is a cheap source of energy and is acceptable to a large number of people. Onions are rich in vitamin C and contain vitamin B to a somewhat less extent. The use of raw onion in salad and for flavoring should be encouraged as an antiscorbutic measure.

6. While the cost per 1,000 calories is quite low compared with that of the rations of other armies, the percentage distribution of expenses is rather defective. Too much money is spent for meat and fish and too little for dairy products, leafy vegetables, and fruits. A better distribution in the food budget for the different food groups, so that less money will be spent for meat and fish and more for milk, vegetables, and fruits, is urgently recommended. If this cannot be done without reducing the total amount of food in the diet, it is recommended that a 5-centavo per capita increase be made in the actual appropriation in order that the soldiers may get a more-balanced ration.

TABLE 12.—*List of the foodstuffs given to the Philippine Constabulary soldiers.*

Meat and fish:
- Beef.
- Corned beef.
- Chicken.
- Choriso (bacon).
- Pork.
- Shrimps.
- Sardines.
- Bañgos.
- Hasahasa.
- Dalagang bukid.
- Daing (hasahasa).

Eggs:
- Chicken and duck eggs.

Milk:
- Cream.

Butter and other fats:
- Butter.
- Margarine.
- Lard.

Grain products:
- Bread.
- Flour.
- Macaroni.
- Rice.
- Sutangjon.
- Misua.

Vegetables and legumes:
- Green peppers.

Vegetables and legumes—Cont.
- Onions.
- Tomato catsup.
- Potatoes.
- String beans.
- Cabbage.
- Peas.
- Tomatoes.
- Mongos.
- Garbansos.
- Pechay.
- Garlic leaves.
- Kangkong.
- Camote leaves.
- Tamarind.

Nuts:
- Coconuts.

Fruits:
- Bananas.

Sugar:
- Cane sugar.
- Sweet (pionono).

Miscellaneous:
- Cocoa.
- Coffee.
- Garlic.
- Ginger.
- Toyo sauce.
- Pimienta.

TABLE 13.—*Menus of meals given in the Manila Garrison from December 4 to December 10, 1935.*

DECEMBER 4

Breakfast:
- Pan de sal with butter.
- Coffee, cream, and sugar.
- Bananas.

Dinner.—Sutangjon con caldo:
- Boiled rice.
- Chicken.
- Beef.
- Sutangjon.
- Sweet (merengue).

Supper.—Mongo guisado:
- Boiled rice.
- Pork.
- Shrimps.
- Bananas.

DECEMBER 5

Breakfast:
- Boiled rice.
- Sardines.
- Taho with sugar and cream.
- Bananas.

Dinner.—Pochero:
- Boiled rice.
- Beef.
- Choriso.
- Pechay.
- Cabbage.
- Garbansos.
- Sweet (grated coconut).

TABLE 13.—*Menus of meals given, etc.*—Continued.

DECEMBER 5—continued.

Supper.—Fried fish and macaroni soup:
- Boiled rice.
- Fish.
- Macaroni.
- Eggs.
- Bananas.

DECEMBER 6

Breakfast:
- Pan de sal with butter.
- Coffee, cream, and sugar.
- Bananas.

Dinner.—Beef afritada
- Boiled rice.
- Beef.
- Tomatoes.
- Pepper.
- Peas.
- Onions.
- Sweet (pionono).

Supper.—Boiled chicken:
- Boiled rice.
- Chicken.
- Pechay.
- Garlic leaves.
- Onions.
- Toyo.
- Bananas.

DECEMBER 7

Breakfast:
- Pan de sal with butter.
- Coffee, cream, and sugar.
- Bananas.

Dinner.—Quimlo:
- Boiled rice.
- Beef.
- Misua.
- Eggs.
- Sweet (coconut pie).

Supper.—Chop suey:
- Boiled rice.
- Beef.
- Shrimps.
- Cabbage.
- Onions.
- Toyo.
- Bananas.

DECEMBER 8

Breakfast.—Samporado:
- Rice.
- Chocolate.
- Cream.
- Sugar.
- Ensemada.

Dinner.—Pochero:
- Boiled rice.
- Beef.
- Pechay.
- Garbansos.
- Bananas (saba).
- Sweet (grated coconut).

Supper.—Sutangjon con caldo:
- Boiled rice.
- Beef.
- Sutangjon.
- Tinapa.
- Bananas.

DECEMBER 9

Breakfast:
- Pan de sal with butter.
- Coffee, sugar, and cream.
- Bananas.

Dinner.—Sinigang:
- Boiled rice.
- Fish (baños).
- Kangkong and camote leaves.
- Sweet (londres).

Supper.—Pork and beans:
- Boiled rice.
- Mongo beans.
- Pork.
- Shrimps.
- Tomatoes.
- Onions.
- Bananas.

DECEMBER 10

Breakfast:
- Pan de sal with butter.
- Coffee, sugar, and cream.
- Bananas.

Dinner.—Afritada:
- Boiled rice.
- Beef.
- Potatoes.
- Peas.

TABLE 13.—*Menus of meals given, etc.*—Continued.

DECEMBER 10—continued.

Dinner.—Afritada—Continued.
- Tomatoes.
- Onions.
- Sweet (piónono).

Supper.—Fried fish and macaroni soup:
- Boiled rice.

DECEMBER 10—continued.

Supper.—Fried fish and macaroni soup—Continued.
- Fish.
- Macaroni.
- Eggs.
- Tomatoes.
- Bananas.

TABLE 14.—*Daily menu proposed for the brigade, by the mess officer, for November 1 to November 15, 1935.*

FRIDAY, NOVEMBER 1

	Peso.
Breakfast:	
Four pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
One banana	0.007
Total	0.062
Dinner.—Pancit:	
Rice	0.03
Pork	0.02
Chicken	0.02
Shrimps	0.02
Mique	0.005
Onions, kinchay, pepper, and toyo	0.01
Bucayo	0.006
Total	0.111
Supper.—Carne guisada:	
Beef	0.04
Lard, onions, and pepper	0.01
Tomatoes, garlic, and toyo	0.007
Piónono	0.006
Total	0.093
Grand total, including fuel	0.296

SATURDAY, NOVEMBER 2

Breakfast:	
Four pieces pan de leche	0.03
Chocolate, cream, and sugar	0.02
One lakatan banana	0.008
Total	0.058

TABLE 14.—*Daily menu proposed, etc.*—Continued.

SATURDAY, NOVEMBER 2—continued.

	Peso.
Dinner.—Bañgos sinigang:	
Rice	0.03
Bañgos	0.05
Camote and kangkong leaves	0.007
Tamarind and salt	0.003
Native onion leaves	0.005
Coconut pie	0.006
Total	0.101
Supper.—Pork and beans:	
Rice	0.03
Pork (chopped fine)	0.03
White beans	0.01
Onions, tomatoes, and garlic	0.005
Condol	0.006
Total	0.081
Grand total, including fuel	0.270

SUNDAY, NOVEMBER 3

Breakfast.—Samporado:	
Rice, chocolate, cream, and sugar	0.025
Four pieces ensemada	0.03
Total	0.055
Dinner.—Pork and beef cocido:	
Rice	0.03
Pork	0.02
Beef	0.02
Potatoes, cabbage, and pechay	0.015
Toyo, onions, and spices	0.005
Saba banana	0.006
Sherbet	0.007
Total	0.103
Supper.—Fried fish:	
Rice	0.03
Fish (sea fish)	0.05
Lard	0.01
Tomato ketchup	0.01
No desert	0.00
Total	0.10
Grand total, including fuel	0.298

TABLE 14.—*Daily menu proposed, etc.*—Continued.

MONDAY, NOVEMBER 4

	Peso.
Breakfast:	
Four pieces pan de sal with butter	0.035
Papaya	0.015
Coffee, cream, and sugar	0.02
Total	0.07
Dinner.—Chicken boiled with malungay leaves:	
Rice	0.03
Chicken	0.06
Malungay, onions, and tomatoes	0.01
Tomatoes, garlic, and salt	0.005
No desert	0.00
Total	0.105
Supper.—Sutangjon con caldo:	
Rice	0.03
Pork (chopped fine)	0.015
Shrimps	0.02
Sutangjon, garlic, and onions	0.01
Toyo	0.005
Cake	0.006
Total	0.086
Grand total, including fuel	0.291

TUESDAY, NOVEMBER 5

Breakfast:	
Pan de leche	0.03
Chocolate, cream, and sugar	0.02
Banana lakatan	0.008
Total	0.058
Dinner.—Shrimps sinigang:	
Rice	0.03
Shrimps	0.04
Banana heart (puso) and tamarind	0.015
Native onions and salt	0.005
Peanut candy (bar)	0.006
Total	0.096

TABLE 14.—*Daily menu proposed, etc.*—Continued.

TUESDAY, NOVEMBER 5—continued.

	Peso.
Supper.—Pork with mongos:	
Rice	0.03
Pork (chopped fine)	0.02
Mongos (ground), onions, and salt	0.01
Daing (dried fish) hasahasa	0.02
Lanzones	0.02
Total	0.10
Grand total, including fuel	0.284

WEDNESDAY, NOVEMBER 6

Breakfast:	
Four pieces pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
Toldan banana	0.008
Total	0.063
Dinner.—Boiled fish (pesa):	
Rice	0.03
Sea fish	0.05
Pechay	0.01
Native onions, garlic, and tomatoes	0.005
Coconut pie	0.006
Total	0.101
Supper.—Picadillo:	
Rice	0.03
Beef (ground)	0.04
Spinach	0.006
Lard, onions, and tomatoes	0.01
Panocha	0.006
Total	0.092
Grand total, including fuel	0.286

THURSDAY, NOVEMBER 7

Breakfast:	
Four pieces pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
Papaya	0.015
Total	0.070

TABLE 14.—*Daily menu proposed, etc.*—Continued.

THURSDAY, NOVEMBER 7—continued.

	Peso.
Dinner.—Calamares adobado:	
Rice	0.03
Squids	0.05
Lard	0.01
Banana	0.007
Total	0.097
Supper.—Beef with habichuelas:	
Rice	0.03
Beef	0.04
Habichuelas	0.005
Lard, onions, and toyo	0.01
Cake	0.006
Total	0.091
Grand total, including fuel	0.288

FRIDAY, NOVEMBER 8

Breakfast:	
Pan de leche	0.03
Chocolate, cream, and sugar	0.02
Banana	0.008
Total	0.058
Dinner.—Bijon con caldo:	
Rice	0.03
Pork (chopped fine)	0.02
Shrimps	0.02
Garlic, onions, and tomatoes	0.01
Bijon and toyo	0.01
Rimas	0.006
Total	0.096
Supper.—Chicken (pesa) boiled with sili leaves:	
Rice	0.03
Chicken	0.05
Sili leaves, native onions, and salt	0.01
Lard, tomatoes, and garlic	0.01
No desert	0.00
Total	0.10
Grand total, including fuel	0.284

TABLE 14.—*Daily menu proposed, etc.*—Continued.

SATURDAY, NOVEMBER 9

	Peso.
Breakfast:	
Pan de sal with butter	0.035
Coffee, milk, and sugar	0.02
Banana	0.008
Total	0.063
Dinner.—Kimlo (Chinese dish):	
Rice	0.03
Pork (chopped fine)	0.01
Beef (chopped fine)	0.01
Chicken cut into small pieces	0.02
Shrimps	0.02
Kimlo	0.01
Toyo, onions, and garlic	0.005
No desert	0.00
Total	0.105
Supper.—Carne afritada:	
Rice	0.03
Beef	0.04
Lard, onions, and garlic	0.01
Potatoes and toyo	0.01
No desert	0.00
Total	0.09
Grand total, including fuel	0.288

SUNDAY, NOVEMBER 10

Breakfast.—Samporado:	
Rice, chocolate, cream, and sugar	0.03
Four pieces ensemada	0.03
Total	0.06
Dinner.—Pinacbet:	
Rice	0.03
Pork	0.03
Ampalaya and talong (eggplant)	0.02
Bagoong	0.01
Onions and fresh tomatoes	0.01
Banana	0.008
Total	0.108

TABLE 14.—*Daily menu proposed, etc.*—Continued.

SUNDAY, NOVEMBER 10—continued

	Peso.
Supper.—Chicken curry:	
Rice	0.03
Chicken	0.05
Potatoes, onions, and tomatoes	0.01
Grated coconut	0.01
Condol	0.006
Total	0.106
Grand total, including fuel	0.304

MONDAY, NOVEMBER 11

Breakfast:	
Pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
Banana	0.008
Total	0.063
Dinner.—Shrimps adobado:	
Rice	0.03
Shrimps	0.05
Lard, ketchup, and onions	0.015
Fresh pechay	0.005
Bucayo	0.006
Total	0.106
Supper.—Carne guisada con salza:	
Rice	0.03
Beef (ground)	0.04
Potatoes, onions, and toyo	0.01
Lard, flour, and spices	0.01
No desert	0.00
Total	0.09
Grand total, including fuel	0.289

TUESDAY, NOVEMBER 12

Breakfast:	
Pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
Banana	0.008
Total	0.063

TABLE 14.—*Daily menu proposed, etc.*—Continued.

TUESDAY, NOVEMBER 12—continued.

	Peso.
Dinner.—Boiled beef with seguedillas:	
Rice	0.03
Beef (ground)	0.04
Seguedillas	0.01
Lard, onions, toyo, and salt	0.01
Lanzones	0.02
Total	0.11
Supper.—Pork and beans:	
Rice	0.03
Pork (chopped fine)	0.04
White beans and toyo	0.01
Tomatoes, onions, garlic, and salt	0.007
Piono no	0.006
Total	0.093
Grand total, including fuel	0.296

WEDNESDAY, NOVEMBER 13

Breakfast:	
Pan de leche	0.03
Chocolate, cream, and sugar	0.02
Banana	0.008
Total	0.058
Dinner.—Boiled chicken (pesa):	
Rice	0.03
Chicken	0.05
Pechay, onions, and salt	0.01
Cake with icing	0.006
Total	0.096
Supper.—Fried fish with sauce:	
Rice	0.03
Fish and lard	0.05
Eggs, onions, toyo, and corn starch	0.01
Peanut bar	0.006
Total	0.096
Grand total, including fuel	0.280

TABLE 14.—*Daily menu proposed, etc.*—Continued.

THURSDAY, NOVEMBER 14

	Peso.
Breakfast:	
Pan de sal with butter	0.035
Coffee, cream, and sugar	0.02
Banana	0.008
Total	0.063
Dinner.—Menudencias guisada:	
Rice	0.03
Menudencias (beef)	0.04
Lard, garlic, and onions	0.01
Potatoes, achuete, and canned tomatoes	0.01
No desert	0.00
Total	0.09
Supper.—Pork with mongo s:	
Rice	0.03
Pork (chopped fine)	0.02
Shrimps	0.02
Mongos, onions, and tomatoes	0.01
Panocha	0.006
Total	0.086
Grand total, including fuel	0.269

NOVEMBER 15.—INAUGURATION OF THE PHILIPPINE COMMONWEALTH

It is presumed that the inaugural parade will take place in the morning. The men are given a heavy breakfast.

Breakfast:	
Fried rice (rice and lard)	0.035
Four tinapa and salt	0.03
Taho (ginger and sugar)	0.007
Total	0.072
Dinner.—Pochero:	
Rice	0.03
Pork sausage (chorizo)	0.02
Beef	0.02
Chicken	0.03
Potatoes and cabbage	0.01
Garbanzos, onions, and tomatoes	0.01
Banana (saba), pechay, and salt	0.01
Magnolia ice cream	0.04
Total	0.17

NOVEMBER 15.—INAUGURATION, ETC.—continued.

	Peso.
Supper.—Beef toyoba:	
Rice	0.03
Beef	0.04
Lard, garlic, and toyo	0.01
Total	0.08
Grand total, including fuel	0.352

This menu (especially with regard to sea fish) is subject to change without notice. The fish market is uncertain, and no one is willing to accept a contract with guarantee.

Following strictly the menu the mess savings per capita during the 15 days' schedule may be summarized as follows:

Date.	Savings. Peso.	Losses. Peso.
November 1	0.004	0.0
November 2	0.03	0.0
November 3	0.002	0.0
November 4	0.009	0.0
November 5	0.016	0.0
November 6	0.014	0.0
November 7	0.012	0.0
November 8	0.016	0.0
November 9	0.012	0.0
November 10	0.00	0.004
November 11	0.011	0.0
November 12	0.018	0.0
November 13	0.006	0.0
November 14	0.031	0.0
November 15	0.00	0.052
Total	[a] 0.181	0.056

[a] Per capita net mess savings equals 0.181 less 0.056 or 0.125 centavos.

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BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

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REVIEWS

Physiologie et physiopathologie du Systéme réticulo-indothélial. Per Albert H. Du Bois. Preface du Prof. M. Roch. Masson et Cie., Paris, 1934. Paper, 204 pp. Price, 36 fr.

The author has done a distinct service to the profession by this elaborate account of the various stages through which the reticulo-endothelial system has passed before it was fairly es-

tablished and accepted. It is undoubtedly due to Aschoff in 1924 that we owe its incorporation into current medical thought as an entity by itself, although as early as 1890 Ranvier had already described his phagocytic clasmatocytes, and may be considered as the precursor of the view, later to prevail, that the connective tissue is not, as was hitherto believed since Virchow's time, a mere supporting tissue, with exclusively mechanistic functions, but has a physiology of its own and important functions to perform, such as the deposition of water and salt in œdema, and the forming of a sort of barrier between the tissues and the circulating blood and the protection of the parenchyma, all of which, when disturbed, give rise to characteristic syndromes.

While there is a tendency at present, in the light of experimental and clinical findings, to extend the term *res* to all the active mesenchyme, the following are specifically considered to be a part of the same:

1. The endothelia of blood and lymph vessels.
2. The fibrocytes.
3. The reticular cells of the spleen, lymph nodes and lymphatic tissue in general.
4. The reticulo-endothelial cells, some sinuses in the lymph nodes, some blood sinuses in the spleen, some capillaries in the hepatic lobules (Kupffercells), some capillaries of the bone marrow, the suprarenal, and the hypophysis.
5. The histiocytes.
6. The splenocytes and monocytes derived from the histiocytes and the reticulo-endothelial cells.

The book is conveniently arranged into three parts. The first part is devoted to an account of the experimental investigations that have gradually led to the establishment of the reticulo-endothelial system; the second part deals with the rôle played by the system in physiology and physiopathology; and the third part is taken up by therapeutics.

A bibliography extending to July, 1933, is appended and will be of much assistance to those who wish further to enlarge their information on some particular phases of the subject. It gives the reader an idea of the tremendous amount of investigative work that has already been done in connection with the reticulo-endothelial system.—C. R.

Dog Encyclopedia; A Complete Reference Work on Dogs. By Will Judy. 2d ed. Judy Publishing Co., Chicago, 1936. xv + 459 pp., illus. Price, $5.

This comprehensive work is a valuable reference to those interested in dogs. The different breeds from the smallest to the largest, from the Chihuahua to the Saint Bernard, are concisely described from the standpoint of origin, development, history, temperament, and utility. An official standard description of the recognized breed appears at the end of each important breed discussed. Descriptions of the wild members of the family Canidæ, such as the cayote, the jackal, and the hyena, are also included. Care, breeding, kenneling, training, and exhibiting of the dog, together with interesting data and lore on canines, collected through the centuries, are some of the other subjects covered. Common diseases are described in a language readily understood even by the ordinary dog fancier.

The book is profusely illustrated. It has no table of contents or index, however, although the different subjects are discussed in alphabetical order. The author has included numerous cross references for the convenience of the reader.—L. M. Y.

Die Fusarien; ihre Beschreibung, Schadwirkung und Bekämpfung. Von Dr. H. W. Wollenweber und Dr. O. A. Reinking. Paul Parey, Berlin, 1935. viii + 355 pp., 95 text figs. Price, in Germany, unbound, Rm. 18; bound, Rm. 20; foreign, unbound, Rm. 13.50; bound, Rm. 15.

Die Fusarien, by Wollenweber and Reinking, deals with fusaria and fusarium diseases. The study of fusaria has long been in a state of confusion, so that few mycologists had the courage to tackle it except in a more or less general way. This publication puts an end to that long period of uncertainty.

The present work consists of two main parts; namely, the systematic study of fusaria by Wollenweber and the fusarium diseases by Reinking. The systematic part represents many years of intensive work. The section on fusarium diseases reveals the experience of the author in plant diseases. Host plants are included and named in alphabetical order and for each is given a description of the fusarium diseases to which it is susceptible, together with a bibliography on these diseases. The hosts range from algæ and fungi to coniferous and broad-leaved trees, including plants of economic importance from temperate

and tropical regions. Control measures, such as hot-water treatment of seeds, and the use of mercurial fungicides and resistant varieties, are included.

This piece of work serves as a key to the solutions of the many problems on fusaria, prepared by workers equipped with special experience as the result of many years of patient and careful labor.—J. M. M.

Economical Cookery. By Elizabeth Craig. Collins, London and Glassgow, 1934. 252 pp. Price, 1 s. net.

This book contains 650 economical recipes especially designed to make the most of inexpensive foods. Unlike Miss Craig's other books, it attempts to meet the problems of even the country housewife, who has storage room of her own and whose chief economy is to use produce from her own garden or foodstuffs which can be procured cheaply in the country.

One of its topics, of great interest to women, is "How to keep slim." Well-balanced reducing menus are set forth. For those who want to reduce but find it quite impossible to follow the diet prescribed, it gives important points to follow daily to cut down weight.

The preparation of a few dishes from cheap ingredients, but attractive enough to set before guests, is described. Home-made drinks, cocktails, and other beverages are included. Several simple menus made from left-overs are presented.

Miss Craig is a cookery expert and a contributor to several journals and magazines dealing with home economics; such as, the Woman's Journal, the Woman Pictorial, the Yorkshire Evening Post, and the Farmer and Stock Breeder. Some of her own publications aside from Economical Cookery are Cooking with Elizabeth Craig, Entertaining with Elizabeth Craig, Elizabeth Craig's Standard Recipes, and Series of Cooking Calendars.—E. G. G.

Oceanic Birds of South America. A Study of Species of the Related Coasts and Seas, Including the American Quadrant of Antarctica, Based upon the Brewster-Sanford Collection in the American Museum of Natural History. By Robert Cushman Murphy. Illustrated from paintings by Francis L. Jacques. Photographs, maps and other drawings. American Museum of Natural History, New York, 1936. Vol. I, xxiv + 640 pp., with plates 1–38, 6 paintings in colors, and text figs. 1–61. Vol. II, pp. 641–1245, plates 39–72, 10 paintings in color, and text figs. 62–80.

In two volumes Doctor Murphy presents the results of his many years of study of the birds of the ocean, from two main

aspects: The physical environment and the oceanic birds themselves.

The continent of South America, the meteorology and hydrology of its coasts, and the influence of these on the avifauna are discussed in a very scholarly manner, under Geographic Background. Under Ornithological Circumnavigation of South America the author describes the main coasts of the continent and the islands about it, and their physical and climatic features, together with their characteristic bird life.

The author presents a systematic account of 183 species and subspecies, belonging to 16 families of 5 orders. The arrangement in Peter's Check-list of the Birds of the World is followed. Under each species or subspecies the following arrangement of annotations is consistently followed: Scientific name, original citation, vernacular names, synonymy, description of the species, description of eggs, distribution, and a general discussion including life history, field observation of collectors, migration, and kindred matters. On certain controversial aspects of the subject the author gives the views held by important specialists, followed by his own opinion, with supporting evidence. The discussions on the phylogeny of the penguin and the identity of steamer ducks of Patagonia are very interesting.

The introduction gives a brief account of the part played in this study by such men as Dr. L. C. Sanford and Mr. F. F. Brewster; a short biography of R. H. Beck, the field worker, is also given.

The work forms one of the most outstanding American contributions to ornithological literature in recent years.—C. G. M.

Aids to the Identification of Anopheline Imagines in Malaya. By B. A. R. Gater. Published by the Government of the Straits Settlements and the Malaria Advisory Board, Federated Malay States. The Secretary, Malaria Advisory Board, Kuala Lumpur: Kelly and Walsh Ltd., 1935. 242 pp., 9 plates, and 235 text figs. Price, $1.

This monograph is regarded by the author as preliminary, subject to revision. Still, however incomplete it may seem, it contains a wealth of information in abridged form, particularly useful to students who are just at the threshold to the intricate and advanced work on anopheline imagines.

Fifty-five species and subspecies of anophelines are presented in the booklet. Of these, forty-one have been recorded in the Malay Peninsula and the rest from neighboring countries in the Malaysian subregion. Fourteen of the species and subspecies presented have been found in the Philippines. These are *Ano-*

pheles annularis, bengalensis, bæzai, barbirostris, insulæflorum, karwari, kochi, leucosphyrus, ludlowi, maculatus, nigerrimus, philippinensis, sinensis, and *tessellatus.*

The classification, table for identification, and illustrations of anopheline imagines are so clearly presented that beginners can easily comprehend them. The anatomy of anopheles adults is extensively dealt with; fine anatomical structures, such as the mouth parts, pharyngeal armature, male and female terminalia, alimentary system, and salivary glands are described. The life history and habits of anophelines are discussed. The discussion of collecting and rearing, of preserving and mounting is comprehensive. However, it might have been well to include a brief description of systematic entomological work on anophelines; that is, the mounting of the adult, with label showing date, place of collection, lot, and number which must correspond to the labels of its larval and pupal skins. The examining, maintaining, and dissecting of anopheline imagines are discussed in a practical way.—A. E.

Mosquitoes of the Ethiopian Region. I.—Larval Economics of Mosquitoes and Taxonomy of Culicine Larvae. By G. H. Hopkins. Sold at The British Museum (Natural History); Bernard Quaritch, Ltd.; Dulau & Co., Ltd.; and the Oxford University press, 1936. 6 unnumbered + 250 pp., 158 text figs. Price, $3.75.

This is a useful reference for those who take up the study of culicines. It is most valuable, of course, to workers in Ethiopia; there are only a few peregrine species included in the text, the descriptions of which may be compared with specimens from other countries. Of such are, at least, *Aëdes* (*Aëdimorphus*) *vexans, Aëdes* (*Banksinella*) *lineatopennis, Aëdes* (*Stegomyia*) *ægypti, Aëdes* (*Stegomyia*) *albopictus, Culex* (*Culex*) *fatigans, Mansonia* (*Mansonioides*) *uniformis,* and *Mucidus mucidus,* which are definitely known to exist in the Philippine Islands. Therefore, it will be very interesting to find out how the local specimens compare with the Ethiopian.

The remarkably well-executed illustrations supplementing the description for each species help to make the text understandable. New terms in mosquitology are introduced and defined.

Of particular value to beginners is the part dealing with the external anatomy of larvæ, in which the author describes and illustrates the structures used in identification. His nomenclature, however, differs in certain respects from that used by Barraud in the Fauna of British India, so that it becomes a little inconvenient if not confusing to those who have already

adopted Barraud's terminology. The author's attempt to differentiate "comb teeth" into "spines" and "scales" may have its uses, but it seems awkward to use "scales" for a larval structure the make-up and function of which are apparently quite different from the true and well-known scales of the adult.

As a whole, the work is excellent, and its companion parts, said to be in preparation, are awaited with interest.—A. E.

We Europeans. By J. S. Huxley and A. C. Haddon. With a contribution by A. M. Carr-Saunders. Harper and Brothers, Publishers, New York and London, 1936. 246 pp. Price, $2.50.

This book deals with racial problems and discusses their relation to nationality. Its purpose is to bring together the chief scientific facts now available on the subject of race and to present them in the light of established scientific principles.

Racial problems are among the urgent actualities of twentieth-century politics. When the concept underlying them has been subjected to a dispassionate analysis, it turns out to be a pseudo-scientific rather than a scientific term.

No single scheme of classification has been devised that will provide a satisfactory pigeon-holding for the various human types in existence.

One of the important conclusions of the authors is the recognition of the extent of our scientific ignorance revealed by an analysis of this fundamental subject.

This valuable reference book is the first of its kind giving scientific treatment of racial problems.—R. E. G.

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PHYSICOCHEMICAL FACTORS IN ANOPHELINE ECOLOGY, II: STUDIES ON TURBIDITY, CHLORIDE, AND IRON.

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In a previous paper(1) I reported the results of studies on the nitrogen content of typical breeding places of *Anopheles minimus* variety *flavirostris,* the most important vector of malaria in the Philippines, and associated moving-water groups of anopheles. A brief review of the literature on physicochemical factors affecting mosquito breeding was included.

In this report are presented the results of analyses for turbidity, chloride, and total iron content of about 170 samples of water collected from the same breeding places. The procedure followed in the examinations is described in the first report.

In Table 1 are presented the occurrence and density of larvæ of *A. minimus* and associated anopheles at different degrees of turbidity. The table shows that the larvæ of these mosquitoes were usually found in clear water with turbidities ranging from 0 to 20 parts per million. However, they were also found in the same breeding places when the turbidity was temporarily increased to 400 parts per million or more at the time of observation. This temporary increase in turbidity was due to the occasional wading of men or animals along the stream or to heavy rains.

In Table 2 it will be observed that *A. minimus* and associated anopheles prefer low concentrations of chloride from mere traces to 7 parts per million. I failed to recover larvæ of these mos-

TABLE 1.—*Occurrence and intensity of anopheline breeding at different degrees of turbidity.*

Turbidity in parts per million.	*Anopheles minimus.*			*Anopheles barbirostris.*			*Anopheles aconitus.*		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*	
0– 9	20	70	1.32	20	70	1.04	20	30	0.15
10– 19	20	90	1.90	20	65	1.57	20	15	0.04
20– 29	5	80	0.42	5	80	0.30	5	0	0.0
30– 39	4	100	1.00	4	25	0.10	4	0	0.0
40– 49	4	100	2.45	4	50	1.20	4	0	0.0
50– 74	3	33	0.27	3	33	0.13	3	0	0.0
75– 99	1	100	2.00	1	100	0.40	1	100	1.60
100–149	2	50	3.70	2	0	0.00	2	0	0.00
150–199	2	100	1.60	2	0	0.00	2	0	0.00
200–249	6	67	1.57	6	33	0.17	6	0	0.00
250–299	1	0	0.00	1	100	1.50	1	0	0.00
300–399	2	100	6.00	2	50	0.30	2	0	0.00
400–499	1	100	4.00	1	100	0.40	1	100	0.20
500–699	----	----	----	----	----	----	----	----	----
700–899	1	0	0.00	1	0	0.00	1	0	0.00

Turbidity in parts per million.	*Anopheles vagus.*			*Anopheles fuliginosus.*			Unidentified.			All species.		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*			*P. ct.*	
0– 9	20	10	0.05	20	0	0.00	20	50	0.59	20	80	3.15
10– 19	20	15	0.03	20	5	0.01	20	80	1.45	20	95	5.00
20– 29	5	0	0.00	5	0	0.00	5	60	0.14	5	100	0.86
30– 39	4	25	0.40	4	0	0.00	4	100	2.10	4	100	3.60
40– 49	4	0	0.00	4	0	0.00	4	75	0.95	4	100	4.60
50– 74	3	0	0.00	3	0	0.00	3	67	0.23	3	67	0.63
75– 99	1	100	0.20	1	0	0.00	1	100	1.00	1	100	5.20
100–149	2	0	0.00	2	0	0.00	2	50	1.00	2	50	4.70
150–199	2	0	0.00	2	0	0.00	2	50	0.50	2	100	2.10
200–249	6	17	0.03	6	0	0.00	6	33	0.97	6	67	2.74
250–299	1	0	0.00	1	0	0.00	1	0	0.00	1	100	1.50
300–399	2	0	0.00	2	0	0.00	2	100	5.70	2	100	12.00
400–499	1	0	0.00	1	0	0.00	1	100	3.40	1	100	8.00
500–699												
700–899	1	0	0.00	1	0	0.00	1	0	0.00	1	0	0.00

TABLE 2.—*Occurrence and intensity of anopheline breeding at different concentrations of chloride.*

Chloride in parts per million.	*Anopheles minimus.*			*Anopheles barbirostris.*			*Anopheles aconitus.*		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*	
(a)	7	71	1.14	7	71	1.60	7	29	0.20
0.5	1	100	3.00	1	100	4.00	1	0	0.00
1.0	13	69	1.55	13	69	1.69	13	31	0.20
2.0	7	100	1.77	7	86	1.47	7	43	0.17
3.0	7	100	2.34	7	86	1.26	7	14	0.03
4.0	7	57	1.23	7	29	0.09	7	0	0.00
5.0	3	100	3.27	3	33	0.13	3	33	0.07
6.0	8	88	2.25	8	13	0.10	8	0	0.00
7.0	6	83	1.17	6	33	0.10	6	0	0.00
8.0	4	75	0.45	4	25	0.05	4	0	0.00
9.0	2	50	0.80	2	100	0.90	2	0	0.00
10.0	2	50	0.70	2	50	0.40	2	0	0.00
11.0	1	100	10.00	1	100	0.60	1	0	0.00

Chloride in parts per million.	*Anopheles vagus.*			*Anopheles fuliginosus.*			Unidentified.			All species.		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*			*P. ct.*	
([a])	7	14	0.06	7	0	0.00	7	43	0.43	7	86	3.43
0.5	1	0	0.00	1	0	0.00	1	0	0.00	1	100	7.00
1.0	13	15	0.03	13	8	0.02	13	61	0.98	13	77	4.47
2.0	7	14	0.03	7	0	0.00	7	86	1.27	7	100	4.71
3.0	7	29	0.11	7	0	0.00	7	71	1.54	7	100	5.29
4.0	7	0	0.00	7	0	0.00	7	57	1.30	7	71	2.62
5.0	3	0	0.00	3	0	0.00	3	100	2.40	3	100	5.87
6.0	8	13	0.20	8	0	0.00	8	75	1.00	8	88	3.55
7.0	6	17	0.03	6	0	0.00	6	50	0.93	6	83	2.13
8.0	4	0	0.00	4	0	0.00	4	50	0.15	4	75	0.65
9.0	2	0	0.00	2	0	0.00	2	50	0.30	2	100	2.00
10.0	2	0	0.00	2	0	0.00	2	50	0.20	2	100	1.30
11.0	1	0	0.00	1	0	0.00	1	100	10.80	1	100	21.40

[a] Traces.

TABLE 3.—*Occurrence and intensity of anopheline breeding at different concentrations of total iron.*

Total iron in parts per million.	*Anopheles minimus.*			*Anopheles barbirostris.*			*Anopheles aconitus.*		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*	
0.00–0.19	7	57	0.09	7	43	0.51	7	0	0.00
0.20–0.39	8	50	0.72	8	38	0.78	8	0	0.00
0.40–0.59	8	100	2.05	8	50	0.42	8	13	0.03
0.60–0.79	9	78	2.29	9	22	0.20	9	0	0.00
0.80–0.99	2	100	1.60	2	100	0.80	2	0	0.00
1.00–1.24	2	100	1.40	2	50	0.40	2	0	0.00
1.25–1.49	1	0	0.00	1	100	0.80	1	0	0.00
1.50–1.74	2	100	0.45	2	50	0.10	2	0	0.00
1.75–1.99									
2.00–2.49	1	100	1.00	1	100	0.80	1	0	0.00
2.50–2.99									
3.00–3.99	3	0	0.00	3	0	0.00	3	0	0.00
4.00–4.99	2	50	2.60	2	0	0.00	2	0	0.00
5.00–5.99									
6.00–6.99	1	100	1.60	1	100	0.20	1	0	0.00

Total iron in parts per million.	*Anopheles vagus.*			*Anopheles fuliginosus.*			Unidentified.			All species.		
	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.	Observations.		Average larvæ per dip.
	Total.	Positive.		Total.	Positive.		Total.	Positive.		Total.	Positive.	
		P. ct.			*P. ct.*			*P. ct.*			*P. ct.*	
0.00–0.19	7	14	0.03	7	0	0	7	57	0.43	7	86	1.06
0.20–0.39	8	0	0.00	8	0	0	8	68	1.80	8	68	3.30
0.40–0.59	8	13	0.07	8	0	0	8	75	1.40	8	100	3.97
0.60–0.79	9	0	0.00	9	0	0	9	56	0.89	9	78	3.38
0.80–0.99	2	0	0.00	2	0	0	2	100	0.80	2	100	3.20
1.00–1.24	2	0	0.00	2	0	0	2	50	0.20	2	100	2.00
1.25–1.49	1	0	0.00	1	0	0	1	0	0.00	1	100	0.80
1.50–1.74	2	0	0.00	2	0	0	2	0	0.00	2	100	0.55
1.75–1.99												
2.00–2.49	1	0	0.00	1	0	0	1	100	1.60	1	100	3.40
2.50–2.99												
3.00–3.99	3	0	0.00	3	0	0	3	0	0.00	3	0	0.00
4.00–4.99	2	50	0.10	2	0	0	2	50	2.50	2	50	5.20
5.00–5.99												
6.00–6.99	1	0	0.00	1	0	0	1	100	0.80	1	100	2.60

quitoes in water having more than 11 parts per million of chloride. On the other hand, it is interesting to note that Balfour(2) reported other species of anopheles breeding in waters with a 2 to 3 per cent concentration of salt. King(3) also reported *A. subpictus* as breeding in ponds with a salt content as high as 2.8 per cent in the Philippines.

In Table 3 it will be seen that *A. minimus* and associated anopheles prefer to breed in streams with concentrations of total iron below 0.8 part per million. However, they were also

TABLE 4.—*Average turbidities in minimus breeding places classified by month and year.*

Location, month, and year.	Observations.		Average larvæ per dip.	Temperature.	Turbidity in parts per million.
	Total.	Positive.			
BULACAN		*P. ct.*		°C.	
July, 1931	11	36	0.25	30.9	22
August, 1931	2	0	0.00	26.0	60
September, 1931	6	0	0.00	27.4	120
October, 1931	3	33	0.40	28.3	18
November, 1931	3	100	3.93	27.7	135
January, 1932	7	86	1.71	24.5	53
February, 1932	4	75	0.60	26.4	9
March, 1932	2	100	3.00	26.4	8
April, 1932	32	100	1.68	27.1	29
May, 1932	3	100	3.13	29.6	17
June, 1932	5	80	0.34	28.3	28
July, 1932	2	0	0.00	29.1	10
August, 1932	4	0	0.00	28.4	6
October, 1932	4	0	0.00	27.9	7
December, 1932	2	0	0.00	24.8	5
May, 1933	2	100	1.70	28.5	10
March, 1934	4	50	1.10	30.1	70
LAGUNA					
January, 1932	1	0	0.00	26.0	70
March, 1932	4	100	4.90	29.2	185
May, 1932	2	100	0.90	28.2	5
February, 1933	5	80	2.88	24.3	41
March, 1933	6	80	4.20	26.4	71
June, 1933	7	80	0.84	25.5	256
January, 1934	2	100	----------	----------	45
February, 1934	3	0	0.00	22.6	[a] 700
April, 1934	3	67	0.40	20.5	10
June, 1934	3	33	0.20	25.1	200
July, 1934	2	100	1.30	27.5	107
CAVITE					
February, 1932	8	75	0.52	26.0	54
April, 1932	1	100	0.60	31.4	10
Do	[b] 2	100	1.55	33.2	52

[a] Due to rains and flood.
[b] Stagnant pools.

temporarily found in much higher concentrations during a rainy season. Williamson(4) and other workers are agreed that iron salts in high concentrations are detrimental to anopheline larvæ.

In Tables 4, 6, and 8 are presented the mean concentrations of turbidity, chloride, and total iron content classified by month and year, and in Tables 5, 7, and 9 the monthly variations in the concentration of these factors are summarized. The tables reveal marked variations in composition of water during certain months, especially in those cases affected by rains and flood, but in general it will be noted that *A. minimus* and its associated moving-water anopheles were found to breed in clear waters with small amounts of chloride and iron. Due to insufficient data I am not yet in a position to specify definitely the toleration limit to any of these physicochemical factors. However, this important problem will be made the subject of future studies.

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TABLE 5.—*Average turbidities in minimus breeding places classified by month.*

Month.	Observations.		Average larvæ per dip.	Temperature.	Turbidity in parts per million.
	Total.	Positive.			
		P. ct.		°C.	
January	10	80	1.50	24.7	53
February	20	65	1.05	25.0	[a] 144
March	16	80	3.40	27.6	93
April	41	98	1.25	27.4	29
May	19	79	1.05	28.3	11
June	28	62	0.46	28.3	169
July	15	40	0.36	26.6	41
August	6	0	0.00	27.2	21
September	6	0	0.00	27.4	120
October	7	14	0.17	28.1	12
November	3	100	3.93	27.7	135
December	2	0	0.00	24.8	5

[a] Due to rains and flood.

TABLE 6.—*Mean concentrations of chloride in minimus breeding places classified by month and year.*

Location, month, and year.	Observations. Total.	Observations. Positive.	Average larvæ per dip.	Tempera-ture.	Chloride in parts per million.
BULACAN		*P. ct.*		°*C.*	
September, 1931	6	0	0.00	27.4	1.67
October, 1931	3	33	0.40	28.3	0.67
November, 1931	3	100	3.93	27.7	0.67
January, 1932	7	86	1.71	24.5	0.36
February, 1932	4	75	0.60	26.4	1.25
March, 1932	2	100	3.00	26.4	2.00
April, 1932	32	100	1.68	27.1	2.41
May, 1932	3	100	3.13	29.6	2.67
June, 1932	5	80	0.34	28.3	2.10
July, 1932	2	0	0.00	29.1	1.00
August, 1932	4	0	0.00	28.4	1.12
October, 1932	4	0	0.00	27.9	0.50
December, 1932	2	0	0.00	24.8	1.00
May, 1933	2	100	1.70	28.5	3.00
March, 1934	4	50	1.10	30.1	5.75
LAGUNA					
January, 1932	1	0	0.00	26.0	4.00
March, 1932	4	100	4.90	29.2	6.25
May, 1932	2	100	0.90	28.2	8.50
February, 1933	5	80	2.88	24.3	6.00
March, 1933	6	80	4.20	26.4	6.33
June, 1933	7	80	0.84	25.5	6.29
January, 1934	2	100	----------	----------	3.50
February, 1934	3	0	0.00	22.6	6.33
April, 1934	3	67	0.40	20.5	4.00
June, 1934	3	33	0.20	25.1	4.00
July, 1934	2	100	1.30	27.5	5.00
CAVITE					
February, 1932	8	75	0.52	26.0	8.25
April, 1932	1	100	0.60	31.4	8.00
Do	[a] 2	100	1.55	33.2	16.50

[a] Stagnant pools.

TABLE 7.—*Mean concentrations of chloride in minimus breeding places classified by month.*

Month.	Observations.		Average larvæ per dip.	Temperature.	Chloride in parts per million.
	Total.	Positive.			
		P. ct.		°*C.*	
January	10	80	1.50	24.7	3.60
February	20	65	1.05	25.0	6.00
March	16	80	3.40	27.6	5.62
April	41	98	1.25	27.4	3.42
May	19	79	1.05	28.3	4.43
June	28	62	0.46	28.3	4.43
July	15	40	0.36	26.6	3.00
August	6	0	0.00	27.2	1.12
September	6	0	0.00	27.4	1.67
October	7	14	0.17	28.1	0.57
November	3	100	3.93	27.7	0.67
December	2	0	0.00	24.8	1.00

TABLE 8.—*Mean concentrations of total iron in minimus breeding places classified by month and year.*

Location, month, and year.	Observations.		Average larvæ per dip.	Temperature.	Total iron in parts per million.
	Total.	Positive.			
BULACAN					
		P. ct.		°*C.*	
February, 1932	4	75	0.60	26.4	0.00
April, 1932	32	100	1.68	27.1	0.58
May, 1932	3	100	3.13	29.6	0.77
June, 1932	5	80	0.34	28.3	1.26
July, 1932	2	0	0.00	29.1	0.20
August, 1932	4	0	0.00	28.4	0.95
October, 1932	4	0	0.00	27.9	0.37
December, 1932	2	0	0.00	24.8	0.70
May, 1933	2	100	1.70	28.5	0.70
March, 1934	4	50	1.10	30.1	1.72
LAGUNA					
May, 1932	2	100	0.90	28.2	0.35
February, 1933	5	80	2.88	24.3	0.57
March, 1933	6	80	4.20	26.4	1.15
June, 1933	7	80	0.84	25.5	1.51
January, 1934	2	100	----------	----------	0.50
February, 1934	3	0	0	22.6	[a] 38.17
April, 1934	3	67	0.40	20.5	1.30
June, 1934	3	33	0.20	25.1	2.50
July, 1934	2	100	1.30	27.5	4.25
CAVITE					
February, 1932	8	75	0.52	26.0	0.40

[a] Due to heavy rains and flood.

TABLE 9.—*Mean concentrations of total iron in minimus breeding places classified by month.*

Month.	Observations.		Average larvæ per dip.	Temperature.	Total iron in parts per million.
	Total.	Positive.			
		P. ct.		°*C.*	
January	10	80	1.05	24.7	0.50
February	20	65	1.05	25.0	[a] 9.10
March	16	80	3.40	27.6	1.38
April	41	98	1.25	27.4	0.65
May	19	79	1.05	28.3	0.63
June	28	62	0.46	28.3	1.74
July	15	40	0.36	26.6	2.22
August	6	0	0.00	27.2	0.95
October	7	14	0.17	28.1	0.38
December	2	0	0.00	24.8	0.70

[a] Due to rains and flood.

NEODIPLOSTOMUM LARAI, A NEW TREMATODE PARASITE OF THE CATTLE EGRET[1]

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TWO PLATES

The family Alariidæ (Tubangui, 1922) Bosma, 1931, has so far only three species representing two genera in this country. They are *Proalaria butasturina* Tubangui, 1932, *Neodiplostomum aluconis* Tubangui, 1933, and *N. crocodilarum* Tubangui and Masiluñgan, 1936, obtained from the small intestine, respectively, of *Butastur indicus, Aluco longimembris,* and *Crocodilus porosus.* This family is further enriched by our finding in the same organ of *Bubulcus ibis coromandus* (Boddaert) of a hitherto unknown species which seems to answer La Rue's specifications (1926) for *Neodiplostomum* Railliet. For this new *Neodiplostomum* we propose the name *Neodiplostomum larai,* in honor of Dr. Hilario Lara, secretary and acting director of the School of Hygiene and Public Health, University of the Philippines, in grateful acknowledgment of his interest in the development of parasitology in this country.

NEODIPLOSTOMUM LARAI sp. nov. Plates 1 and 2.

This description is based on a study of fifteen specimens from the small intestines of *Bubulcus ibis coromandus* (Boddaert), caught around Laguna de Bay, a body of fresh water a few miles south of Manila.

Body small, ventrally bent, 0.81 to 1.28 mm in length, divided by a constriction into two body regions of which the anterior portion is about twice as long as the posterior. Forebody foliaceous, delicate, 0.55 to 0.81 mm by 0.25 to 0.43 mm; the posterior portion of the lateral borders ventrally inrolled, uniting with each other behind hold-fast organ or haptor (Price, 1934) making a free underhanging margin (Plate 1, fig. 1). Cuticle smooth. Oral sucker subterminal, 0.035 mm across;

[1]Aided by a special research grant from the Board of Regents, University of the Philippines. Received for publication November 28, 1936.

acetabulum behind middle of forebody, 0.03 to 0.04 mm in diameter. Pharynx muscular, 0.03 by 0.02 mm; œsophagus short, 0.052 mm long; intestinal cæca simple, their blind ends terminating a variable distance from the posterior border of anterior testis to middle of seminal vesicle. Hold-fast organ, or haptor, roughly ovoid, 0.14 to 0.19 mm by 0.10 to 0.17 mm, between acetabulum and underhanging margins of forebody, extending laterally beyond limits of intestinal cæca. Adhesive glands paired, oval, 0.03 to 0.09 mm by 0.02 to 0.04 mm, posterodorsal to haptor, their caudal ends usually diverging from each other. Suctorial cups, or earlike appendages, absent.

Hind body semicylindrical, 0.26 to 0.47 mm by 0.17 to 0.22 mm, bearing the bulk of the reproductive organs, dragging the copulatory bursa behind. Bursa copulatrix posterodorsal, prominent, 0.088 to 0.11 mm long with the transverse diameter (0.075 to 0.15 mm) greatest behind its middle; with lateral lips dorsally incurved but never uniting with each other, forming an incomplete cup which envelopes a central, caudally directed genital cone, 0.028 by 0.024 mm (Plate 2, figs. 1 and 2).

Female organs.—Ovary transversely oval, 0.04 to 0.08 mm by 0.03 to 0.07 mm, in front of transverse branch of anterior testis, median or slightly towards the left side of the median line, near junction of two body regions. Oviduct could not be made out. Mehlis's gland longitudinally oval, 0.08 by 0.07 mm in front of middle of hind body on left side, lying between and partly overlapped by the left arms of the testes. Uterus usually projects anterodorsally from near right side of Mehlis's gland to a short distance behind ovary; then, bending sharply under itself, it proceeds posteriad gradually narrowing in caliber near neck of seminal vesicle to form the vagina which penetrates the genital cone enveloped by the copulatory bursa. Vitellaria made up of irregularly shaped follicles abundant in the hind body, extending from shortly behind posterior testis to as far forward as middle of forebody gradually fading out in front of acetabulum.

Male organs.—Testes tandem, large, crowding out hind body. Anterior testis transversely and irregularly T-shaped, chiefly postovarial, with lateral arms (transverse arm 0.07 by 0.081 mm; longitudinal, 0.19 by 0.081 mm), directed ventrally, the longitudinal arm partly overlapped by right branch of posterior testis. Posterior testis irregularly V-shaped, each arm (0.19 by 0.09 mm) directed somewhat anterodorsally, the right partly

covering the anterior testis and the left arm together with the transverse branch of the anterior testis partly overlapping Mehlis's gland. Vasa efferentia and vas deferens could not be made out. Seminal vesicle ovoid, 0.08 by 0.05 mm, chiefly confined to right side of hind body, may or may not be partly covered by posterior testis (depending upon the degree of distention) and discharges behind through a short ejaculatory duct which joins the vagina before the latter enters the genital cone.

Eggs oval, brown, thin-shelled, operculated, 70 to 81 μ by 53 to 74 μ. Excretory system not clearly determined.

Specific diagnosis.—Neodiplostomum: Total length, 0.81 to 1.28 mm; forebody foliaceous, 0.55 to 0.81 mm by 0.25 to 0.43 mm; hind body semicylindrical, 0.26 to 0.47 mm by 0.17 to 0.22 mm, bearing the bulk of the reproductive organs. Ovary transversely oval, 0.04 to 0.08 mm by 0.03 to 0.07 mm, median or slightly towards left side of median line, in front of transverse branch of anterior testis. Mehlis's gland oval, 0.08 by 0.07 mm, anterior to middle half of hind body, partly overlapped by the left arms of the testes. Vitellaria most abundant in hind body, extending from behind posterior testis to middle of forebody, gradually fading out in front of acetabulum. Anterior testis mostly postovarial, irregularly and transversely T-shaped, with longitudinal (0.19 by 0.81 mm) and transverse (0.07 by 0.08 mm) branches directed ventrally; posterior testis irregularly V-shaped, each arm (0.19 by 0.09 mm) directed anterodorsally. Seminal vesicle behind posterior testis; ejaculatory duct short, joins vagina before latter enters genital cone. Eggs brown, thin-shelled, 70 to 81 μ by 53 to 74 μ.

Host.—Bubulcus ibis coromandus (Boddaert).

Location.—Small intestine.

Locality.—Biñan, Laguna Province, Luzon.

Type specimen.—Parasitological collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

Remarks.—Our species most closely resembles *Neodiplostomum orchilongum* Noble, 1936, from which it differs in the following respects: (*a*) the anterior testis is chiefly postovarial, and has the form of a transverse irregular T with the longitudinal and transverse arms directed ventrally. The anterior testis of *N. orchilongum* on the other hand may be described as a small segment of a thick spiral, situated chiefly in the anterior left portion of the hind body and entirely to the left of the ovary

and Mehlis's gland, with the most posterior portion lying farthest to the left of the body and the most anterior portion reaching the anterior limits of the hind body, closely applied to Mehlis's gland; (*b*) the posterior testis has the form of an irregular V, with the arms directed anterodorsally. The corresponding testis of *N. orchilongum* is very atypical in shape, being elongated and twisted in such a manner that the anterior portion lies ventrally on the right side of the body while a more elongated projection extends diagonally along the left side with the posterior termination curving slightly to the right and reaching the dorsal body wall; (*c*) Mehlis's gland, which never reaches the ovary in our specimens, lies between and is partly overlapped by the left branches of the testes, instead of lying on the right side of the hind body between the anterior testis and the ovary, with the anterior and ventral margins usually projecting beyond corresponding limits of the latter organ in *N. orchilongum;* and (*d*) the vitellaria in our specimens are irregularly distributed in the hind body, and never confined to two compact relatively massive ventral columns as they are in *N. orchilongum.*

ACKNOWLEDGMENT

We are greatly indebted to Dr. Marcos A. Tubangui, of the Bureau of Science, for his valuable suggestions, and to Dr. Candido M. Africa, head of the Department of Parasitology, School of Hygiene and Public Health, University of the Philippines, for his kindness in going over this paper.

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ILLUSTRATIONS

[Abbreviations: *ac*, Acetabulum; *ag*, adhesive gland; *bc*, bursa copulatrix; *exc*, excretory space; *gc*, genital cone; *hf*, hold-fast organ, or haptor; *int*, intestine; *mg*, Mehlis's gland; *oes*, œsophagus; *os*, oral sucker; *ov*, ovary; *ph*, pharynx; t_1, t_2, testes; *utd*, descending limb of uterus; *vag*, vagina; *vg*, vitelline glands; *vs*, seminal vesicle.]

PLATE 1

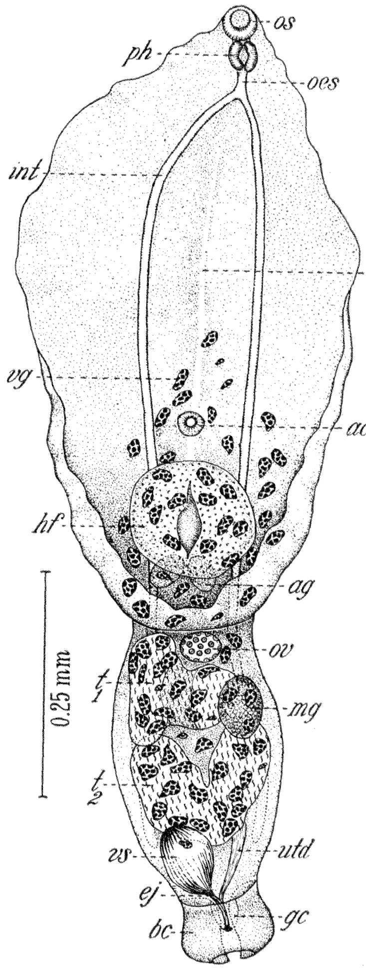
FIG. 1. *Neodiplostomum larai* sp. nov., camera-lucida drawing of the entire worm, ventral view. (Drawn by H. Rolda.)

2. *Neodiplostomum larai* sp. nov., microphotograph of entire worm, dorsal view, low power, × 100.

PLATE 2

FIG. 1. *Neodiplostomum larai* sp. nov., bursa copulatrix, microphotograph, dorsal view, high power, × 450.

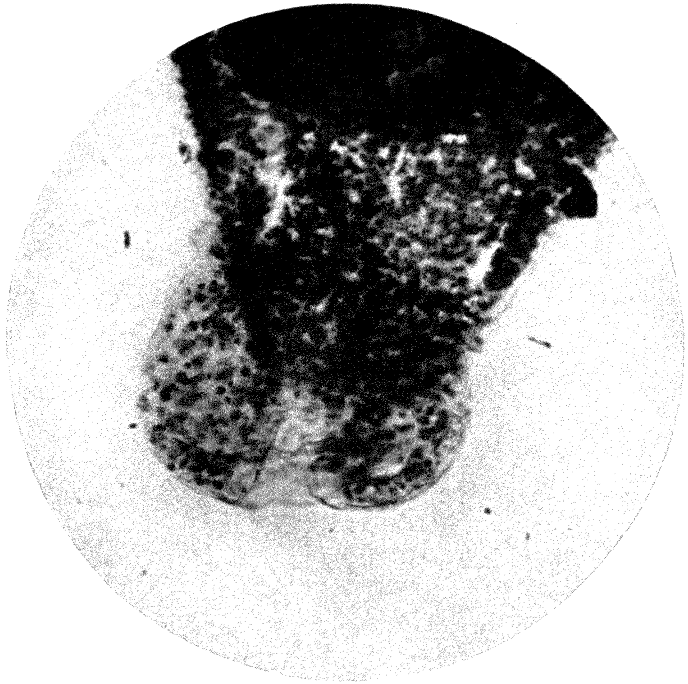
2. *Neodiplostomum larai* sp. nov., bursa copulatrix, drawn from fig. 1, Plate 2, dorsal view, × 450.



1


2

PLATE 1.



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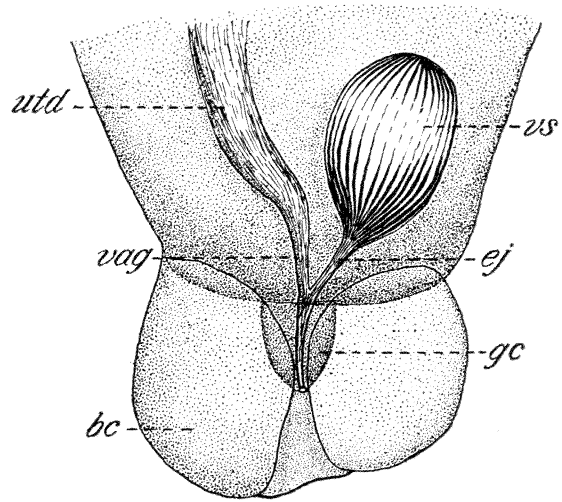

2

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXIV[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

ONE PLATE

The crane flies discussed at this time were collected by Mrs. M. E. Walsh in southeastern Sumatra and in various parts of Java. I am very much indebted to Mrs. Walsh for her appreciated interest in saving specimens of these flies when on collecting expeditions to remote parts of the Malayan islands. The types of the novelties are preserved in my collection of Tipulidæ.

The localities where the specimens were taken have been briefly discussed by Mrs. Walsh:

TANDJONG SAKTI, Benkoelen, southeastern Sumatra, altitude 1,650 to 2,000 feet, May 24 to June 30, July 16 to 19, 1935.

BOEKIT JTAM, Benkoelen, altitude 1,000 to 2,000 feet, June 11 to 15, June 18, June 24 to July 2, 1935.

MOEARA TENAM, Benkoelen, June 16 to 23, July 4 to 14, 1935.

POELOE PANAS, Benkoelen, altitude 2,500 feet, June 1 to 4, 1935.

TANGGAMOES, Lampangs, altitude 1,500 to 2,000 feet, July 22 to August 5, 1935.

TJOLO, northern Java, altitude about 2,100 feet, on the Goenoeng Moeria, where the Pasangrahan is located, December 1 to 8, 1935.

GOENOENG MOERIA, northern Java, a mountain with seven tops, quite isolated from the central chain of the island by an immense alluvial plain, altitude 3,000 to 4,000 feet, December, 1935.

NGLIRIP, central Java, a small village in the djati forests, between Rembang and Bodjanejoro, altitude about 300 feet, January 1 to 7, 1936.

SOEMBER BRANTAS, east Java, Mount Ardjano, on a pass between Ardjano and Audjarmora, altitude 6,000 feet, January 14 to 25, 1936.

[1] Contribution from the entomological laboratory, Massachusetts State College.

DJOENGGO, on Mount Ardjano, altitude 4,500 to 7,000 feet, January, 1936.

LANANG, a small township at the foot of Mount Ardjano, altitude 1,500 feet, February, 1936.

NONGKODJADJAR, in the Tengger Mountains, eastern Java, altitude 3,000 to 3,600 feet, February, 1936.

PETAPAU and ARDJARA, villages on Kangean, a small island northeast of Madura, eastern Java, February, March, 1936.

TIPULINÆ

DOLICHOPEZA (NESOPEZA) DIRA sp. nov. Plate 1, fig. 1.

Size relatively small (wing, female, 9.2 millimeters); general coloration of mesonotal præscutum and scutum chestnut-brown, the posterior sclerites of notum darker brown; pleura obscure yellow; legs dark brown, the tarsi snowy white, all basitarsi with central portion darkened; wings with a weak brown tinge, the stigma and a very narrow seam on cord darker brown; Sc_2 ending opposite fork of Rs; medial forks deep; cell 2d A long and narrow; abdominal segments bicolorous, yellow and brown.

Female.—Length, about 10 millimeters; wing, 9.2.

Frontal prolongation of head obscure yellow; palpi dark brown. Antennæ brownish black, the pedicel obscure yellow; flagellar segments subcylindrical, with short inconspicuous verticils. Head yellowish brown; anterior vertex relatively wide, exceeding three times the diameter of the scape.

Mesonotal præscutum and scutum chiefly chestnut-brown, the posterior sclerites of notum darker brown. Pleura obscure yellow, scarcely variegated by darker, the pleurotergite more infuscated. Halteres elongate, brownish black. Legs with the coxæ and trochanters yellow; femora dark brown; tibiæ brown, the tips narrowly blackened; tarsi snowy white, the central portions of the basitarsi more or less infuscated. Wings (Plate 1, fig. 1) with a weak brown tinge; stigma oval, darker brown; a narrow to scarcely evident brown seam on cord; veins brownish black. Venation: Sc relatively long, Sc_2 ending opposite fork of Rs, the latter strongly arcuated at origin; R_{2+3} longer than Rs; medial forks deep; cell 2d A relatively narrow, yet markedly wider than in *cuneata* or *subcuneata,* the vein shorter.

Abdominal tergites weakly bicolorous, dark brown, the basal rings of the proximal and intermediate segments restrictedly yellow, the outer segments more uniformly darkened; sternites yellow, the caudal portions of the more basal segments narrowly darkened.

Habitat.—North Java.

Holotype, female, Goenoeng Moeria, altitude 3,000 to 4,000 feet, December, 1935 (*Walsh*).

The nearest regional ally is *Dolichopeza* (*Nesopeza*) *subcuneata* Alexander, which has the medial forks of the wing even deeper and cell 2d A longer and narrower, differing, furthermore, in the details of coloration of the body, halteres, and legs.

DOLICHOPEZA (NESOPEZA) PALLIDITHORAX de Meijere.

Dolichopeza pallidithorax DE MEIJERE, Tijd. voor Ent. 56 suppl. (1913) 4–5.

The type, a male, was from Nongkodjadjar, in the Tengger Mountains, east Java, collected in January by Jacobson.

Males and females, Goenoeng Moeria, north Java, altitude 3,000 to 4,000 feet, December, 1935; Mount Ardjano, east Java, altitude 6,000 to 7,000 feet, January, 1936 (*Walsh*).

De Meijere's type was somewhat broken and the following supplementary details are given: Legs black, the tarsi, except the basal half or somewhat less of the basitarsi, snowy white. Wings with a few scattered macrotrichia in outer end of cell R_5, and in cases also in cells R_3 and M_1, in most cases the latter very restricted in number, usually only one or two in either cell, but sometimes more. Medial forks very short.

SCAMBONEURA SUMATRENSIS sp. nov. Plate 1, fig. 2.

Antennal scape infuscated, pedicel light yellow; basal flagellar segments weakly bicolorous; præscutal stripes black, bordered by deeper black; mediotergite clear light gray, the posterior border with two dusky areas; wings with anterior cord moderately bowed; dark areas on abdominal tergites black, without bluish reflections.

Female.—Length, about 15 millimeters; wing, 13.

Frontal prolongation of head obscure yellow, the dorsal surface, together with the conspicuous nasus, darker; palpi chiefly obscure yellow, the intermediate segments vaguely darker. Antennæ with scape infuscated; pedicel clear light yellow; basal segments of flagellum very weakly bicolorous, black, with the apices restrictedly yellow, the amount decreasing on the outer segments; flagellar segments beyond the third or fourth uniformly blackened; longest verticils a trifle shorter than the segments; terminal flagellar segment partly fused with the penultimate. Front and anterior vertex orange, silvery pruinose, the latter color also involving the anterior orbits; posterior

portion of head brownish gray, the anterior vertex with a linear velvety black median line that extends high on to the simple vertical tubercle.

Pronotum dark brown, paler medially. Mesonotal præscutum with the interspaces brownish yellow, a little brighter in front, the lateral borders of the sclerite light gray pruinose; three subopaque blackish stripes that are narrowly bordered by deeper black, especially the median stripe; scutal lobes dull black, the median area restrictedly paler; scutellum obscure yellow; mediotergite pale in color, clear light gray pruinose, the posterior border with two dusky areas. Pleura weakly pruinose, vaguely marked with darker on anepisternum and ventral sternopleurite, the pteropleurite and pleurotergite light gray. Halteres with stem brownish yellow, brighter at extreme base, the knob infuscated. Legs with fore coxæ darkened on cephalic face, the remainder of coxæ paler, the surface heavily pruinose; trochanters yellow; femora obscure yellow, the tips scarcely darkened but tufted with a group of black setæ; tibiæ and tarsi passing through brown to black. Wings (Plate 1, fig. 2) subhyaline, cell Sc clear light yellow; stigma small, pale brownish yellow; veins dark brown, the prearcular area and veins Sc and R more yellowish. Venation: Anterior cord rather strongly bowed; medial forks deep.

Abdominal tergites obscure yellow, the intermediate and outer segments brighter yellow, narrowly bordered laterally with deep velvety black; central portion of each tergite occupied by a black quadrate area; sternites uniformly light yellow; genital shield intensely black; cerci horn-colored, straight, the apices obtuse.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*).

The nearest ally seems to be *Scamboneura quadrata* de Meijere, from Kambangan Island, south of western Java. The latter species differs in numerous details of color, as the yellow antennal scape, uniformly blackish brown flagellum, the reddish brown median præscutal vitta, blackish brown mediotergite with broad lateral borders, and the blackish blue areas on the abdominal tergites. The present fly is the most westerly species as yet discovered.

NEPHROTOMA NIGRITHORAX (de Meijere).

Pachyrrhina nigrithorax DE MEIJERE, Bijd. tot de Dierkunde 21 (1919) 18.

The type, a female, was from Air Njuruk, Dempu, Palembang, Sumatra, altitude 4,550 feet, collected in August by Jacobson.

SUMATRA, Goenoeng Singgalang, altitude 5,200 feet, 1926 (*Jacobson*); Brastagi, May, 1918 (*J. B. Corporaal*). WEST JAVA, Tjibodas, Mount Gedeh, altitude 4,200 feet, April 2, 1934 (*Walsh*).

The Javan specimen is very similar to the Sumatran material, except that the femora are more extensively blackened, including the outer two-thirds or more of the segment.

TIPULA TJIBODENSIS Alexander.

Tipula tjibodensis ALEXANDER, Proc. U. S. Nat. Mus. 49 (1915) 188; Philip. Journ. Sci. 57 (1935) 86.

The types were from Tjibodas, Mount Gedeh, west Java.

Three females, Goenoeng Moeria, north Java, altitude 3,000 to 4,000 feet, December, 1935 (*Walsh*).

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) LUTEITHORAX sp. nov. Plate 1, fig. 3.

Thorax entirely pale yellow, unmarked; head black, eyes holoptic; antennæ black, the flagellar verticils of unusual length; legs brown; wings whitish subhyaline, the prearcular and costal regions clear light yellow; stigma oval, brown, conspicuous; Rs about twice as long as the basal section of R_{4+5}; cell 1st M_2 rectangular, relatively small, shorter than any of the veins beyond it; cell 2d A narrow.

Male.—Length, about 7.5 millimeters; wing, 9.

Rostrum brown; palpi brownish black. Antennæ with scape brown; pedicel and flagellum black; flagellar segments oval to cylindrical, the more basal segments with short glabrous apical pedicels; longest verticils of outer segments of unusual length, exceeding three times the length of the segments; terminal segment one-half longer than the segment. Head black, the surface subnitidous; eyes holoptic, eliminating the anterior vertex.

Thorax entirely pale yellow, immaculate. Halteres with stem pale yellow, the knob weakly darkened. Legs with the coxæ

and trochanters yellow; femora brown, the bases somewhat more brightened; tibiæ and tarsi pale brown. Wings (Plate 1, fig. 3) whitish subhyaline, the prearcular and costal regions clear light yellow; stigma oval, brown, conspicuous; veins pale brownish yellow, brighter in the yellow areas. Venation: Sc relatively long, Sc_1 ending about opposite r-m, somewhat swollen at end; Sc_2 far from tip of Sc_1, before fork of Rs; Rs about twice the basal section of R_{4+5}; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 rectangular, relatively small, shorter than any of the veins beyond it, with m-cu shortly before midlength; anal veins divergent, cell 2d A narrow.

Abdominal tergites dark brown, the segments obscure yellow laterally; sternites and hypopygium obscure yellow.

Habitat.—Central and east Java.

Holotype, male, Mount Ardjano, east Java, altitude 6,000 to 7,000 feet, January, 1936 (*Walsh*). Paratype, 1 male, Nglirip, central Java, altitude 300 feet, January 1 to 7, 1936 (*Walsh*).

By Edwards's key to the species of the subgenus *Libnotes* [2] the present fly runs to couplet 61, disagreeing with all species beyond this point by the coloration of the thorax. It is most nearly allied to species such as *subfamiliaris* Alexander, yet differs in the pattern of the thorax and wings.

LIMONIA (LIBNOTES) CLAUDA sp. nov. Plate 1, fig. 4.

Mesonotal præscutum almost covered by a polished black discal shield; halteres and legs blackened; wings with a strong dusky tinge, especially on outer part of wing; cells C and Sc, together with the stigma, more blackened; r-m unusually oblique; Rs about two and one-half times the basal section of R_{4+5}; cell 1st M_2 small, m about twice the basal section of M_3; m-cu beyond midlength of cell 1st M_2; cell 2d A narrow; abdominal tergites uniformly dark brown.

Female.—Length, about 8 millimeters; wing, 9.

Head broken.

Pronotum brownish black medially, obscure yellow on sides. Mesonotal præscutum chiefly covered by a polished black discal shield comprised of the three entirely confluent stripes, the obscure yellow ground color restricted to the humeral and lateral portions; scutal lobes black, the median area paler; scutellum and mediotergite dark brown. Pleura obscure yellow, the ventral sternopleurite a little infuscated. Halteres black-

[2] Journ. Fed. Malay States Mus. 14 (1928) 74–80.

ened, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow; remainder of legs brownish black, the femoral bases scarcely brightened. Wings (Plate 1, fig. 4) with a strong dusky tinge, cells C and Sc, together with the stigma, more blackened; cells beyond the cord slightly more infumed than those of basal portion of wing; veins black. Venation: Sc relatively long, Sc_1 ending nearly opposite the outer end of the unusually oblique r-m; Sc_2 opposite fork of Rs, the latter about two and one-half times the basal section of R_{4+5}; free tip of Sc_2 and R_2 in transverse alignment, both pale; cell 1st M_2 small, m about twice the basal section of M_3; m-cu beyond midlength of cell 1st M_2 and longer than the distal section of Cu_1; cell 2d A narrow.

Abdominal tergites uniformly dark brown; sternites obscure yellow, the outer segments a little darker.

Habitat.—East Java.

Holotype, female, Mount Ardjano, altitude 6,000 to 7,000 feet, January, 1936 (*Walsh*).

The nearest ally of the present fly seems to be *Limonia* (*Libnotes*) *luteithorax* sp. nov., both species having cell 2d A of the wings unusually narrow, much more so than in related species. The present fly differs further in the blackened præscutal disk, the strongly infuscated wings, and in the venational details, as the unusually oblique r-m and the relative proportions of veins m and the basal section of M_3. By Edwards's key to the species of *Libnotes* [3] the fly runs to couplet 63, disagreeing with all species beyond this point in the characters diagnosed above.

LIMONIA (PSEUDOGLOCHINA) QUERULA sp. nov. Plate 1, fig. 5.

Mesonotum dark brown; antennæ relatively long, the flagellar segments with conspicuous apical pedicels; pleura chiefly covered by a very broad, pale, longitudinal stripe; halteres black; tibiæ with a single narrow dark ring; wings with a faint dusky tinge, the wing tip and cord faintly seamed with darker; Sc_1 ending beyond the fork of Rs, Sc_2 about opposite the origin of this vein; m-cu close to fork of M; vein 2d A relatively long and extended.

Male.—Length, about 6.5 millimeters; wing, 5.8.

Rostrum brown; palpi black. Antennæ relatively long, black throughout; flagellar segments subcylindrical, with conspicuous

[3] Loc. cit.

apical pedicels; segments with a dense erect pubescence and long, unilaterally arranged verticils. Head brown.

Pronotum yellow. Mesonotum dark brown, the præscutum paler medially before suture; posterior sclerites of notum slightly pruinose. Pleura chiefly occupied by a very broad, pale, longitudinal stripe, extending from the prothorax to the base of abdomen, the stripe slightly narrowed behind, the posterior portion a little pruinose; pleurotergite and ventral sternopleurite black. Halteres black. Legs with the coxæ and trochanters black, the fore coxæ a little brightened at base; fore femora yellow, the tips narrowly brownish black; mid-femora black, with a narrow, obscure yellow, subterminal ring; posterior femora uniformly black; tibiæ and tarsi snowy white, the former with a single narrow blackened ring at near mid-length. Wings (Plate 1, fig. 5) with a very faint dusky tinge; stigma subcircular, dark brown; wing tip and narrow seams along cord pale brown; veins brownish black to black. Trichia of veins long and coarse. Venation: Sc relatively long, Sc_1 ending beyond fork of Rs, Sc_2 opposite to just before origin of Rs; basal section of R_{4+5} arcuated; R_{2+3} about two-thirds the length of vein R_3 alone; medial forks relatively deep; m-cu close to fork of M; vein 2d A relatively long and extended.

Abdominal tergites bicolorous, dark brown, the segments brownish yellow before apices; sternites more clearly bicolorous, the caudal margin broadly yellow; hypopygium dark.

Habitat.—East Java.

Holotype, male, Nongkodjadjar, Tengger Mountains, altitude 3,600 feet, February, 1936 (*Walsh*).

Limonia (*Pseudoglochina*) *querula* is most nearly related to *L.* (*P.*) *angustapicalis* Alexander (Luzon). The latter has the halteres and the posterior femora differently colored and with the venational details distinct, as the shorter petiole of cell 2d M_2 and the less-extended vein 2d A. The pale but evident dark seam along the wing cord of the present fly is not found in *angustapicalis*.

LIMONIA (PSEUDOGLOCHINA) UNICINCTIPES Alexander.

Limonia (*Pseudoglochina*) *unicinctipes* ALEXANDER, Philip. Journ. Sci. 40 (1929) 336–337.

Recorded from the Philippines and Borneo.

One female, Soekaboemi, west Java, altitude 1,800 feet, February, 1934 (*Walsh*).

LIMONIA (PSEUDOGLOCHINA) KOBUSI (de Meijere).

Dicranomyia kobusi DE MEIJERE, Bijd. tot de Dierkunde 18 (1904) 91–92.

EAST JAVA, Nglirip, altitude 300 feet, January, 1936 (*Walsh*).

HEXATOMINI

PSEUDOLIMNOPHILA NYCTERIS sp. nov. Plate 1, fig. 6.

Thorax intensely black; antennæ black throughout, the flagellar verticils very long; halteres dusky; legs dark brown to brownish black, the femoral bases obscure yellow; wings strongly tinged with yellowish brown, stigma very small, darker brown; costal fringe relatively long and very dense; Sc_1 ending just beyond fork of Rs; R_{1+2} about twice R_2 alone; cell M_1 present, shorter than its petiole; m-cu at near one-third the length of the rectangular cell 1st M_2; abdominal tergites black.

Male.—Length, about 8 millimeters; wing, 7.

Rostrum and palpi dark brown. Antennæ black throughout; basal flagellar segments long-oval, the outer segments more cylindrical; verticils of outer flagellar segments very long and conspicuous, the longest about two and one-half times the length of the segments. Head dark brown; anterior vertex wide, slightly exceeding twice the diameter of the scape.

Pronotum and mesonotum black, the mediotergite slightly pruinose. Pleura, including the pleurotergite and dorsopleural membrane, black. Halteres dusky. Legs with the coxæ black, the middle coxæ somewhat paler; trochanters obscure yellow; femora brownish black, the bases obscure yellow; tibiæ and tarsi dark brown. Wings (Plate 1, fig. 6) with a strong yellowish brown tinge, more saturated in outer radial field; costal region slightly more yellowish; stigma very small, darker brown; veins brown. Costal fringe (male) relatively long and very dense. Venation: Sc_1 ending just beyond fork of Rs, Sc_2 near its tip; R_{1+2} about twice R_2 alone; cell M_1 present, shorter than its petiole; cell 1st M_2 rectangular, with m-cu at near one-third its length; cell 2d A wide; anterior arculus preserved.

Abdominal tergites black, the sternites obscure brownish yellow; hypopygium dark.

Habitat.—Sumatra (Benkoelen).

Holotype, male Tandjong Sakti, altitude 1,650 to 2,000 feet, May 24 to 31, 1935 (*Walsh*).

Pseudolimnophila nycteris is readily told from other regional species by the intense black color of the entire thoracic region.

Genus HEXATOMA Latreille

Hexatoma Latreille, Gen. Crust. et Ins. 4 (1809) 210.

Subgenus ERIOCERA Macquart

Eriocera MACQUART, Dipt exot. 1 1 (1838) 74.

The very extensive group *Eriocera* is well represented in the Oriental Region. At this time I am describing several new species from Java and southeastern Sumatra, and further take the opportunity to provide additional data concerning the distribution of several other members of the subgenus from the same area.

HEXATOMA (ERIOCERA) SUBAURANTIA sp. nov. Plate 1, fig. 7.

Belongs to the *rubrescens* group; body almost uniformly orange; a circular dark brown spot on extreme dorsal anepisternum immediately before wing root; legs chiefly dark brown; wings fulvous brown; stigma small, darker brown; veins beyond cord with abundant macrotrichia; veins R_{1+2} and R_2 subequal; cell M_1 about twice as long as its petiole; cell 1st M_2 long-rectangular, twice as long as wide, with m-cu at near midlength.

Female.—Length, about 12 millimeters; wing, 11.

Rostrum yellow, palpi black. Antennæ 8-segmented (female); scape yellow, pedicel and flagellum brownish black; flagellar segments gradually decreasing in length to the end. Head entirely orange; vertical tubercle broad and low, virtually simple; a few scattered black setæ on vertex.

Mesonotum uniformly orange, immaculate; præscutal setæ very sparse, tiny, and pale. Pleura orange-yellow, with a circular dark brown spot on extreme dorsal anepisternum, immediately before wing root. Halteres dark brown throughout. Legs with the coxæ and trochanters orange; femora obscure yellow basally, passing into dark brown; tibiæ dark brown; outer tarsal segments a little paler. Wings (Plate 1, fig. 7) with a strong fulvous-brown suffusion, cell Sc clearer yellow; stigma very small, long-oval, darker brown; veins yellowish brown to brown. Abundant macrotrichia on veins beyond cord, excepting R_{1+2} and distal section of Cu_1. Venation: Sc_1 ending nearly opposite fork of R_{2+3+4}; veins R_{1+2} and R_2 subequal, either less than one-half R_{2+3}; R_{2+3+4} and R_{3+4} subequal; basal section of vein R_5 shorter than r-m; cell M_1 present, nearly twice as long as its petiole; cell 1st M_2 long-rectangular, twice as long as wide,

exceeding vein M_3 beyond it; m-cu at near midlength of cell, longer than distal section of Cu_1.

Abdomen orange, without markings or differentiated basal rings; valves of ovipositor elongate.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Tandjong Sakti, altitude 1,650 to 2,000 feet, June 11 to 20, 1935 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera*[4] the present fly runs to couplet 31, where it agrees most nearly with *Hexatoma* (*Eriocera*) *aurantia* (Brunetti) of the eastern Himalayas. The latter species differs conspicuously in several details of body-coloration, but especially in the coloration and venation of the wings, as the lack of a stigma and the short and broad cell 1st M_2 which is only a little longer than wide. It should be noted that in *aurantia* R_{1+2} is nearly twice as long as vein R_2, disagreeing with couplet 27 of Edwards's key.

HEXATOMA (ERIOCERA) KARNYI (Edwards).

Eriocera karnyi EDWARDS, Treubia 6 (1925) 167.

WEST JAVA, Mount Djampangs, Tengeh, altitude 1,500 to 2,000 feet, March, June, September, 1933; February, May, 1934 (*Walsh*). Soekaboemi, altitude 1,800 feet, February, April, 1934 (*Walsh*).

HEXATOMA (ERIOCERA) FERRUGINOSA (van der Wulp).

Eriocera ferruginosa VAN DER WULP, Notes Leyden Mus. 7 (1885) 13.

WEST JAVA, Mount Djampangs, Bodjang Kalang, September, 1935 (*Walsh*). Soekaboemi, altitude 1,800 feet, March, 1933 (*Walsh*).

HEXATOMA (ERIOCERA) COMMODA sp. nov.

Belongs to the *dichroa* group; size large (wing, male, 20 millimeters or more); mesonotal præscutum with four reddish stripes that are narrowly bordered by black; legs black; wings brown, cells C and Sc conspicuously more yellowish; veins R_{1+2} and R_{2+3+4} subequal; cell 1st M_2 rectangular, nearly twice as long as wide, with m-cu at or beyond midlength; abdominal segments two to five deep orange to reddish brown, the subterminal segments blackened.

Male.—Length, about 19 to 23 millimeters; wing, 18 to 23.

Female.—Length, about 20 to 24 millimeters; wing, 15 to 19.

[4] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

Rostrum black, pruinose; palpi black. Antennæ of male 7-segmented, of female 9-segmented; scape brownish black, sparsely pruinose; pedicel dark brown; basal segment of flagellum brownish yellow, the outer segments black. Head black, sparsely pruinose, especially on sides of posterior vertex; vertical tubercle (male) simple but very conspicuous; setæ of head sparse but conspicuous, black.

Mesonotum with the ground color obscure brownish gray, with four reddish stripes that are narrowly bordered by black; posterior interspaces with conspicuous appressed yellow setæ; posterior sclerites of mesonotum black, the centers of the scutal lobes reddish. Pleura deep reddish brown to liver brown; setæ sparse, restricted to mesepisternum. Halteres with stem dark brown, the knob blackened. Legs with the coxæ and trochanters dark brown; remainder of legs black. Wings long and relatively narrow, almost uniformly suffused with brown; cells C and Sc conspicuously more yellowish; no stigma; veins brown, more yellowish in the costal region. Trichia of veins beyond cord exceedingly sparse and scattered, but including veins R_{1+2}, R_3, R_4, R_5, and M_1. Venation: Sc_1 ending opposite R_2, its tip strongly arcuated to angulated and weakly spurred, the latter condition in the female sex; Sc_2 just beyond fork of R_{2+3+4}; veins R_{1+2} and R_{2+3+4} subequal or nearly so; cell M_1 from one and one-half to nearly two times its petiole; cell 1st M_2 rectangular, nearly twice as long as wide, with m-cu at or beyond midlength.

Basal abdominal tergite dark brown; tergites two to five, inclusive, deep orange to reddish brown; succeeding segments darker brown to brownish black; sternites more uniformly pale; no differentiated glabrous rings on segments; hypopygium brownish yellow.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Moeara Tenam, June 16 to 23, 1935 (*Walsh*). Allotopotype, female, July 4 to 14, 1935 (*Walsh*). Paratopotypes, 6 males and females, with the holotype.

By Edwards's key to the Old World species of the subgenus [5] the present fly runs to *Hexatoma* (*Eriocera*) *ferruginosa* (van der Wulp), which appears to be its closest ally. The present species differs most evidently in the uniformly black legs and distinct venation, as the much deeper forks beyond the cord, longer petiole of cell M_1, distal position of m-cu, and other

[5] Loc. cit.

characters. In *ferruginosa* the trichia of the outer radial veins are very numerous.

HEXATOMA (ERIOCERA) PÆNULATA (Enderlein).

Eriocera pænulata ENDERLEIN, Zool. Jahrb. Syst. 32 (1912) 43–44.

SUMATRA, Moeara Tenam, Benkoelen, July 4 to 14, 1935 (*Walsh*).

JAVA, Goenoeng Moeria, north Java, altitude 3,000 to 4,000 feet, December, 1935 (*Walsh*). Sindaglaija, altitude 4,000 to 5,000 feet (*Frederick Muir*).

HEXATOMA (ERIOCERA) VERTICALIS (Wiedemann).

Megistocera verticalis WIEDEMANN, Aussereur. zweifl. Ins. 1 (1828) 56.

WEST JAVA, Mount Djampangs, altitude 1,500 to 2,000 feet, March, May, 1933; April, 1934 (*Walsh*).

HEXATOMA (ERIOCERA) PLUTONIS sp. nov. Plate 1, fig. 8.

Size small (wing, 8.5 millimeters); general coloration velvety black, the præscutum with three polished black stripes; halteres and legs black; wings narrow, strongly tinged with blackish; outer veins of wing with abundant macrotrichia; veins R and R_3 subequal; R_{2+3+4} subequal to R_{1+2}; cell M_1 present; m-cu at or close to fork of M_{3+4}; abdomen black, the segments with nacreous or slightly pruinose basal rings.

Male.—Length, about 9 millimeters; wing, 8.5.

Female.—Length, about 9.5 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ of male 8-segmented, black throughout; flagellar segments gradually decreasing in length, the last about two-thirds the penultimate. Head velvety black.

Pronotum black. Mesonotal præscutum velvety black, with three more polished black stripes, without pruinosity; scutum velvety black, the centers of the lobes similarly polished black; posterior sclerites of notum black. Pleura polished black. Halteres relatively elongate, black throughout. Legs slender; coxæ black; trochanters dark brown; remainder of legs black, the femoral bases somewhat brightened. Wings (Plate 1, fig. 8) relatively narrow, with a strong blackish tinge, the axillary region a little brightened; veins darker than the ground color. Abundant macrotrichia on veins beyond cord. Venation: Sc_1 ending a short distance beyond r-m; Rs of moderate length, subequal to R, arcuated at origin; R_{2+3+4} subequal to R_{1+2} and a

little longer than R_{2+3}; cell M_1 present, subequal to its petiole; m-cu at fork of M_{3+4} (male) or some distance before this fork, at near three-fourths the length of cell 1st M_2 (female).

Abdomen black, the basal portions of the more proximal tergites more nacreous and pruinose; sternites with the pruinose bases more extensive, only a little less in degree than the velvety black apical portions; hypopygium brownish black. Genital shield of female brown; valves of ovipositor horn yellow.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*). Allotopotype, female. Paratopotype, female.

By Edwards's key to the species of *Eriocera* [6] the present fly runs to *Hexatoma* (*Eriocera*) *lygropis* (Alexander) of Formosa, a large, powerfully built crane fly that is not closely allied to the present insect. This latter is one of the smallest and most delicate members of the subgenus in the Oriental fauna.

HEXATOMA (ERIOCERA) CANINOTA sp. nov. Plate 1, fig. 9.

Size small (wing, female, 9 millimeters); general coloration velvety black, the præscutum with three nearly confluent, silvery-gray stripes; scutal lobes similarly silvery pruinose; antennæ of female 8-segmented, black throughout; legs and halteres black, the femoral bases restrictedly brightened, especially the posterior pair; wings black; veins beyond cord with abundant macrotrichia; R_{2+3+4} shorter than R_{2+3} and subequal to R_{1+2}; cell M_1 present, about as long as its petiole; m-cu at near midlength of the rectangular cell 1st M_2; abdomen velvety black, the basal rings of the segments more nacreous; genital shield fiery orange.

Female.—Length, about 11 millimeters; wing, 9.

Rostrum very short, black; palpi black. Antennæ (female) 8-segmented, black throughout; flagellar segments gradually decreasing in length outwardly, the last a little more than one-half the length of the penultimate; longest verticils of the intermediate segments subequal in length to the segment itself. Head velvety black; vertical tubercle slightly notched at summit.

Pronotum black. Mesonotal præscutum black, with three pruinose, silvery-gray stripes that are virtually confluent behind, the median one insensibly split by a capillary dark vitta; scutum dull black, the centers of the lobes silvery pruinose; scutellum and postnotum black, more sparsely pruinose. Pleura

[6] Loc. cit.

black. Halteres black. Legs relatively slender, black, the femoral bases somewhat brighter, especially the lower surface of the posterior femora where more than the basal half is involved. Wings (Plate 1, fig. 9) with a strong blackish tinge; stigma indicated by a narrow darker area lying in cell Sc_1 above vein R_2; a pale streak in cell 1st A adjoining the basal half of the vein; veins dark brown. Veins beyond cord with abundant macrotrichia. Venation: Sc_1 ending about opposite the fork of R_{2+3+4}, Sc_2 about opposite the fork of Rs; Rs angulated and sometimes weakly spurred at origin; R_{2+3+4} subequal to R_{1+2} and much shorter than R_{2+3}; cell M_1 subequal in length to its petiole; cell 1st M_2 rectangular, with m-cu at midlength; cell 2d A of moderate width.

Abdomen velvety black, the proximal tergites with narrow, more nacreous, basal rings, the subterminal segments uniformly black; sternites with the basal rings more extensive, obscure brownish yellow, the surface sparsely pruinose. Genital segment fiery orange; valves of ovipositor long and slender, somewhat more yellowish horn color.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*).

Hexatoma (*Eriocera*) *caninota* is most nearly allied to *H.* (*E.*) *plutonis* sp. nov., differing especially in the silvery thoracic markings and in the venation, as the short R_{2+3+4} and the position of m-cu at near midlength of cell 1st M_2.

HEXATOMA (ERIOCERA) INDECORA sp. nov. Plate 1, fig. 10.

Head and thorax dark gray, the præscutum with four dull black stripes that are narrowly bordered with deeper black; femora brownish yellow, the tips narrowly blackened; wings suffused with rich fulvous-brown, the prearcular and costal areas even brighter, R_{1+2} longer than R_{2+3+4}; cell M_1 present but small and tending to become evanescent; abdominal segments one to four orange-yellow, unmarked except for the dark pleural membrane; outer segments, including hypopygium, black.

Male.—Length, about 14 to 17 millimeters; wing, 11.5 to 15.

Rostrum black, pruinose; palpi black. Antennæ (male) 8-segmented; scape and pedicel black; flagellum yellowish brown to brown, the outer segments darker; flagellar segments cylindrical, gradually decreasing in length outwardly; terminal segment a little longer than the penultimate. Head dark brown,

the anterior vertex and orbits light gray; vertex with numerous long black and yellow setæ; vertical tubercle relatively high, simple.

Pronotum black, pruinose. Mesonotal præscutum dark gray, with four dull black stripes that are narrowly bordered with deeper black; vestiture restricted to the interspaces, long and conspicuous, chiefly pale; scutal lobes dark brown, the median area gray; scutellum dull blackish gray, with abundant long yellow setæ; mediotergite black. Pleura black, sparsely pruinose; mesepisternum with long setæ. Halteres black. Legs with the coxæ and trochanters black, sparsely pruinose; femora brownish yellow to yellowish brown, the bases clearer yellow, the tips rather narrowly (1.5 millimeters) blackened, the amount subequal on all legs; tibiæ and tarsi black. Wings (Plate 1, fig. 10) almost uniformly suffused with rich fulvous-brown, the prearcular and costal regions even brighter; veins pale yellowish brown. Macrotrichia present on veins R_3, R_4, and distal section of R_5, restricted to virtually lacking on outer medial branches. Venation: Sc_1 ending opposite the slightly oblique R_2, Sc_2 about opposite the fork of R_{2+3+4}; R_{1+2} longer than R_{2+3+4}; R_{2+3} a little longer than R_2; cell M_1 usually present but tending to become evanescent, lacking in one paratype specimen; when best developed, shorter than its petiole; m-cu from one-third to one-half its length beyond the fork of M.

Abdomen with segments one to four orange-yellow, unmarked except for a narrow pleural darkening; outer segments, including hypopygium, black; no differentiated basal pattern or polishing on any of the segments.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Tandjong Sakti, altitude 1,650 to 2,000 feet, June 1 to 10, 1935 (*Walsh*). Paratopotypes, 2 males, May 26 to June 10, 1935 (*Walsh*).

By Edwards's key to the species of *Eriocera*[7] the present fly runs to couplet 45, where it disagrees with all species beyond this point. It agrees fairly well with *Hexatoma* (*Eriocera*) *umbripennis* (Edwards) of Penang, but is amply distinct in all details of structure and coloration. The figure of the type of *umbripennis*[8] shows cell M_1 lacking or very evanescent, but in the original definition of the species it is described as being present and a little longer than its petiole.

[7] Loc. cit. [8] Tom. cit. pl. 10, fig. 2.

HEXATOMA (ERIOCERA) MESOPYRRHA (Wiedemann).

Limnobia mesopyrrha WIEDEMANN, Aussereur. zweifl. Ins. I (1828) 26.

JAVA, Mount Djampangs, altitude 2,000 feet, September, 1933, April, 1934 (*Walsh*). Wynkoope Bay, April, 1933 (*Walsh*).

HEXATOMA (ERIOCERA) FLAVOHIRTA sp. nov. Plate 1, fig. 11.

Belongs to the *mesopyrrha* group; general coloration black, the præscutum, scutum, and scutellum with conspicuous yellow setæ; halteres and legs black, the femoral bases restrictedly paler; wings dark brown, the broad prearcular region and a band before cord yellow, the latter not reaching the costal border; abdomen velvety black, segments two to four clear orange-yellow with black lateral borders; hypopygium brown; genital segment of female orange.

Male.—Length, about 16 to 17 millimeters; wing, 15 to 15.5.

Female.—Length, about 23 to 24 millimeters; wing, 18 to 18.5.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum with basal segment obscure yellow, the succeeding segments passing through brownish yellow to black; antennæ 7-segmented (male); flagellar segments gradually decreasing in length outwardly. In the holotype the second flagellar segment abnormally swollen at base on both antennæ. Head dull black, the surface gray pruinose, leaving areas of the ground color on either side of the posterior vertex; vertical tubercle simple, relatively low; setæ of head black.

Mesonotum opaque black, the præscutal stripes only a little more grayish black than the deep black interspaces, the lateral and humeral portions more grayish; præscutum, scutum, and scutellum with long conspicuous appressed yellow setæ, on the præscutum involving not only the interspaces but the surface of the stripes themselves, only the anterior ends of the intermediate stripes being destitute of them; mediotergite glabrous. Pleura dull black or brownish black, the surface weakly pruinose; yellow setæ on dorsal sternopleurite in male and on both sternopleurite and anepisternum in female. Halteres black. Legs with the coxæ black, pruinose; trochanters black; femora black, the bases narrowly yellowish on foreleg, somewhat more extensively infuscated on middle and hind legs; tibiæ and tarsi black to brownish black. Wings (Plate 1, fig. 11) dark brown, in the male with cell C more reddish brown, cell Sc more yellowish; extreme wing base dark; prearcular region broadly pale

yellow; an incomplete light yellow crossband before cord, relatively narrow but widened in radial field, extending from vein R_1 to the posterior margin of wing on either side of vein Cu_1; veins brown, more yellowish in the brightened areas. Costal fringe greatly reduced (male) to abundant (female), as in the group. Venation: Sc_1 ending opposite the transverse R_2; R_{1+2} a little longer than R_{2+3+4}; cell M_1 present; m-cu at near midlength of cell 1st M_2, longer than the distal section of Cu_1.

Abdomen velvety black; segments two to four clear orange-yellow, the segments narrowly bordered laterally with black; segments without leaden or scoriaceous basal rings; hypopygium brown to brownish black. In the female, the extreme caudal borders of tergites two to four are insensibly darkened; genital segment deep orange; cerci very long and slender, black, with pale tips.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*). Allotype, female, Moeara Tenam, July 4 to 14, 1935 (*Walsh*). Paratopotype, male. Paratype, female, with the allotype.

By Edwards's key to the Old World species of *Eriocera*[9] the present fly runs to couplet 86, disagreeing widely with both included species, *bicolor* Macquart (*bengalensis* Alexander) and *cingulata* (de Meijere). It is more closely related to *mesopyrrha* (Wiedemann), differing in the black coloration, more distinctly yellow wing pattern, and the abdominal coloration. It should be noted that there is a slight error in Edwards's key, where *cingulata* runs to that group of species having black legs (couplet 84). In reality, the species has the femora yellow with the tips rather narrowly but conspicuously blackened.

HEXATOMA (ERIOCERA) MULTICOLOR sp. nov. Plate 1, fig. 12.

Mesonotal præscutum and scutum velvety black, without markings; antennæ with scape and pedicel black, flagellum yellow; scutellum obscure orange, mediotergite yellow; legs with the femora yellow, the tips narrowly black, tibiæ and tarsi darkened; wings brown, the anal cells paler; a triangular whitish discal area; prearcular and costal regions restrictedly yellowish; wing tip narrowly yellow; cell M_1 present; abdominal tergites polished nacreous, with the caudal margins narrowly ringed with velvety black, the outer segments more uniformly polished black; hypopygium yellow.

[9] Tom. cit. 70–78.

Male.—Length, about 14 millimeters; wing, 13.

Rostrum black, sparsely pruinose; palpi black. Antennæ (male) 7-segmented, short; scape black, pruinose; pedicel brownish black; flagellum yellow, the end of the outer segment a little darkened. Head black, more pruinose adjoining the eyes; vertical tubercle bifid at apex.

Mesonotal præscutum and scutum velvety black, without markings; scutellum obscure orange, parascutella black; mediotergite uniformly yellow, the pleurotergite black; vestiture of mesonotum relatively short and sparse but erect. Pleura, including the dorsopleural membrane, black. Halteres short, stem brown, knob blackened. Legs with the coxæ and trochanters brownish black; femora yellow, the tips narrowly blackened, the amount subequal on all legs; tibiæ brown, with black vestiture; tarsi black. Wings (Plate 1, fig. 12) with the ground color brown, the anal cells more grayish brown; prearcular region clear light yellow; costal border, including cells C and Sc to beyond the stigma, more brownish yellow; a triangular or sagittate white area near center of the wing, the point directed basad, the area occupying cells R_1, R, and M; wing tip light yellow, involving cells R_3, R_5, and M_1; veins dark, more luteous in the yellow areas. Costal fringe long and dense; macrotrichia on R_3, most of R_4, and distal section of R_5; scattered trichia on outer ends of outer medial veins. Venation: Rs about one-third longer than R; R_{2+3+4} and R_{2+3} subequal; cell M_1 subequal to its petiole; m-cu at near three-fourths to four-fifths the length of cell 1st M_2.

Abdominal tergites chiefly polished nacreous, glabrous, and more or less opalescent, the caudal margins narrowly ringed with velvety black, becoming narrower and more restricted outwardly, lacking on the subterminal segments which are more uniformly polished black; basal sternites brown, the succeeding segments more yellowish; subterminal sternites four to eight more blackened; hypopygium yellow.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*).

By Edwards's key to the Old World species of the subgenus [10] the present fly runs to *Hexatoma* (*Eriocera*) *plumbolutea* (Edwards) of Assam, differing in the nature of the vestiture and in numerous details of coloration of the thorax, wings, and abdomen.

[10] Loc. cit.

None of the numerous species of *Eriocera* subsequently described by Edwards and the writer is more closely allied.

HEXATOMA (ERIOCERA) NOVELLA sp. nov. Plate 1, fig. 13.

Belongs to the *nepalensis* group; general coloration velvety black; antennal flagellum yellow; legs yellow, the tips of the femora and tibiæ narrowly blackened; wings brown, the base light yellow; a broad white crossband before the cord, entirely traversing the wing; outer branches of R with macrotrichia; R_2 oblique; cell M_1 lacking; m-cu close to fork of M_{3+4}; abdomen black, tergites two to five very heavily light gray pruinose, especially segments two and five, segments three and four more dotted with gray; genital shield of female and the male hypopygium black.

Male.—Length, about 12 millimeters; wing, 10.

Female.—Length, about 15 millimeters; wing, 11.

Rostrum brownish black; palpi black. Antennæ of male 8-segmented, of female apparently 10-segmented; scape and pedicel brownish black, pruinose; flagellum yellow, the terminal segment (male) or segments (female) darkened; flagellar segments cylindrical, gradually decreasing in length outwardly. Head brownish black, with long erect setæ.

Thorax velvety black, without a distinct pattern; præscutal interspaces with relatively sparse erect setæ that are shorter than those of the head. Halteres dusky. Legs with the coxæ black; trochanters brown; femora yellow, the tips rather narrowly but conspicuously blackened, the amount subequal on all legs and involving about the distal sixth or seventh; tibiæ and basitarsi brownish yellow, the tips narrowly blackened; remainder of tarsi black. Wings (Plate 1, fig. 13) dark brown, variegated only by conspicuous light yellow coloration at the base, extending to just beyond the arculus, and a complete white crossband before the cord, extending from C before the outer end of Sc_1 to the posterior border in outer end of cell 1st A; bases of anal cells narrowly whitened; veins brown, yellow in the pale areas. Costal fringe dense; macrotrichia on all radial veins beyond cord; outer branches of M with only a few scattered trichia. Venation: Sc_1 ending nearly opposite r-m; Rs subequal to or a little longer than R, in cases weakly angulated at origin; R_2 oblique, at or beyond fork of R_{2+3+4}; tip of R_3 rather strongly upcurved; cell M_1 lacking; m-cu close to fork of M_{3+4}.

Abdomen black, with tergites two to five very heavily light gray pruinose, not at all polished, leaving the extreme caudal borders of the segments black; segments three and four with the ground color interrupted to produce a dotted effect adjoining the setæ; remainder of abdomen, including the hypopygium and genital shield of female, velvety black; ovipositor long and slender, horn-colored.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Tandjong Sakti, altitude 1,650 to 2,000 feet, July 16 to 19, 1935 (*Walsh*). Allotype, female, Moeara Tenam, June 16 to 23, 1935 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera*[11] the present fly runs to *assamensis* (Edwards) of Assam, which still seems to be its closest ally. It differs conspicuously in the small size, coloration of the antennal pedicel, and the complete white crossband of the wing, this involving cells C and Sc, which are darkened in *assamensis*.

HEXATOMA (ERIOCERA) ACROSTACTA (Wiedemann).

Limnobia acrostacta WIEDEMANN, Dipt. exot. 1 (1821) 14.

SUMATRA, Tanggamoes, Lampangs, altitude 1,500 to 2,000 feet, July 22 to August 5, 1935 (*Walsh*).

WEST JAVA, Mount Djampangs, altitude 1,500 to 2,000 feet, June, 1933 (*Walsh*).

The species shows a somewhat unusual range in size (male, length, 20 to 27 millimeters; wing, 13 to 18). In some specimens the middorsal abdominal stripe is less clearly defined than in others, the median darkened portion being paler at the anterior end of the individual segment than on its caudal portion, partially interrupting the stripe.

HEXATOMA (ERIOCERA) MALEVOLENS sp. nov. Plate 1, fig. 14.

Allied to *acrostacta;* thorax deep velvety black; antennæ 8-segmented in both sexes, flagellum of male black, of female yellowish brown to obscure yellow; head pruinose above; femora yellow, the tips narrowly blackened; wings dark brown or brownish black, the anal cells paler; a vague brightening on vein M shortly before level of origin of Rs; extreme wing tip white; m-cu at from one-half to three-fourths the length of cell 1st M_2; abdomen (male) elongate, velvety black; segments two to

[11] Loc. cit.

five, inclusive, yellow, with the caudal margins blackened, not forming a median stripe; genital shield of female dark, heavily pruinose.

Male.—Length, 20 to 23 millimeters; wing, 12 to 15.

Female.—Length, about 18 to 20 millimeters; wing, 12.5 to 14.

Rostrum and palpi black. Antennæ 8-segmented in both sexes, in cases with the terminal segment indistinctly divided; scape and pedicel black, pruinose; flagellum of male black, of female much paler, yellowish brown to obscure yellow. Head black, heavily pruinose.

Thorax deep velvety black, almost destitute of setæ. Halteres black. Legs with the coxæ and trochanters black; femora yellow, the tips rather narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ obscure yellow, the tips very narrowly and vaguely darkened; tarsi black. Wings (Plate 1, fig. 14) strongly suffused with dark brown or black, the anal cells paler; a vague brightening on vein M shortly before the level of origin of Rs; extreme wing tip white, including the outer end of cell R_4 and adjoining portion of cell R_3; veins dark. Venation: Sc_2 in alignment with the slightly oblique R_2; R_{2+3+4} subequal to or a little shorter than the basal section of R_5 and less than one-half R_{1+2}; cell M_1 lacking; m-cu at from one-half to three-fourths the length of cell 1st M_2.

Abdomen of male elongate, as in *acrostacta* and allies; basal segment velvety black, segments two to five yellow, with the caudal margins black, the color continued a short distance cephalad on the individual segments but not forming an uninterrupted or scarcely broken middorsal stripe, as in *acrostacta;* succeeding tergites and hypopygium black; in cases the lateral basal portions of tergite six slightly brightened; segments without differentiated basal rings. In the female, abdomen shorter, the caudal margins of the brightened tergites a little more extensively darkened, but still not forming a continuous stripe; ovipositor with genital shield dark, heavily pruinose.

Habitat.—East Java.

Holotype, male, Nongkodjadjar, Tengger Mountains, altitude 3,600 feet, February, 1936 (*Walsh*). Allotopotype, female, pinned with type. Paratopotypes, 6 of both sexes.

The nearest ally of the present fly is *Hexatoma* (*Eriocera*) *acrostacta* (Wiedemann), which has the abdomen similarly elongated in the male sex, differing in the deep reddish thorax, conspicuous whitened band before cord of wings, and the usually

unbroken middorsal stripe on abdomen. The reduction in the amount of white on the wings makes the present fly somewhat like *H.* (*E.*) *albipunctata* (van der Wulp). I am indebted to Doctor de Meijere for an authentic specimen of the latter species, which agrees in all details with van der Wulp's description. This fly has R_2 nearly transverse, subequal to R_{1+2}; cell 1st M_2 subquadrate, with m-cu at midlength; pale apical wing spot restricted to cell R_4; no other pale areas on wing.

HEXATOMA (ERIOCERA) BASILARIS (Wiedemann).

Limnobia basilaris WIEDEMANN, Dipt. exot., 1 (1821) 15.

JAVA, Mount Djampangs, altitude 1,500 to 2,000 feet, July, 1933; February, April, 1934 (*Walsh*).

Radjornandala, Preanger, altitude 1,200 feet, December, 1935 (*Walsh*).

HEXATOMA (ERIOCERA) INTERSTITIALIS sp. nov. Plate 1, fig. 15.

General coloration velvety black; head heavily pruinose; femora yellow, the tips blackened; wings brownish black, the prearcular region black; an incomplete white crossband before cord, together with two small, clearly delimited white marks basad of this band; wing tip pale, bicolorous, the extreme margin yellow, bordered internally by white; veins Sc_2 and R_2 in approximate or actual transverse alignment; cell M_1 lacking; cell 1st M_2 short, with m-cu lying far distad; abdominal segments velvety black, with dark-colored glabrous basal rings; genital shield of ovipositor black, pruinose.

Female.—Length, about 12 to 13 millimeters; wing, 9 to 10.

Rostrum black, sparsely pruinose; palpi black. Antennæ (female) 10-segmented; scape and pedicel black, the former sparsely pruinose; flagellum black or with the basal two segments brownish yellow, the outer segments passing into black; antepenultimate and penultimate segments subequal, the terminal a little longer. Head black, heavily silver-gray pruinose, especially on the front and broad anterior vertex, the color continued onto the posterior vertex as a triangular area; vertical tubercle low.

Thorax deep velvety black, without evident stripes or markings; thorax virtually destitute of setæ. Halteres black. Legs with the coxæ and trochanters black; femora yellow, the tips rather narrowly (1 to 1.2 millimeters) and abruptly blackened, the amount subequal on all legs; tibiæ brown, the tips narrowly more blackened; tarsi black. Wings (Plate 1, fig. 15) with the

ground color brownish black, anal cells somewhat paler; prearcular region dark; cells C and Sc more yellowish brown; a complicated white pattern, including an incomplete narrow crossband before cord, extending from veins R_1 to 1st A, and two small, clearly defined dashes before this band, one crossing cells R and M before the origin of Rs, the other transverse, crossing Rs at near one-third the length; wing tip bicolorous, the extreme margin pale yellow, the remainder white, extending from tip of vein R_{1+2} almost to vein M_{1+2}; veins brown, paler in the white areas. Rather sparse scattered trichia on radial veins beyond cord, lacking in medial field. Venation: Sc_1 ending just beyond R_2, Sc_2 only a short distance from its tip and in alignment with R_2 or virtually so; R_{1+2} very long, approximately twice R_{2+3+4}; R_{2+3} shorter than R_2, subperpendicular; cell M_1 lacking; cell 1st M_2 short, with m-cu lying at or beyond four-fifths the length.

Abdomnal tergites velvety black, the basal rings of the segments broadly glabrous, nacreous brown, without yellow tones; genital shield black, pruinose; cerci elongate, horn yellow, blackened basally.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Moeara Tenam, June 16 to 23, 1935 (*Walsh*).

Paratopotype, female, July 4 to 14, 1935 (*Walsh*).

The present fly is most nearly allied to *Hexatoma* (*Eriocera*) *basilaris* (Wiedemann) and *H.* (*E.*) *pannosa* (Enderlein), differing in the diagnostic features listed, as the intensely black, nearly glabrous thorax, darkened wing base, and darkened nacreous bases of the abdominal segments. The fact that there are only two basal white areas on the wing disc should be noted.

HEXATOMA (ERIOCERA) ARGYROCEPHALA sp. nov. Plate 1, fig. 16.

General coloration of thorax velvety black; head above silver gray; antennal flagellum pale basally; thorax almost glabrous; knobs of halteres obscure yellow; femora yellow, the tips narrowly blackened; wings dark, the prearcular region light yellow; a narrow white crossband before cord, extending from vein R_1 to 1st A; two small white spots in cells R_1 and M; wing tip narrowly white; R_2 oblique; cell M_1 lacking; abdomen black, segments two to four (male) or two and three (female) yellow, narrowly darkened basally; male hypopygium black; ovipositor with genital shield heavily pruinose above.

Male.—Length, about 14 to 17 millimeters; wing, 9 to 12.

Female.—Length, about 16 to 18 millimeters; wing, 11.

Rostrum and palpi black. Antennæ of male 8-segmented, of female 10-segmented; scape and pedicel black, heavily pruinose; basal one or two flagellar segments obscure yellow, the outer segments passing through light to dark brown; flagellar segments gradually decreasing in length outwardly. Head above silvery gray, including the front, anterior vertex and cephalic portion of posterior vertex, the remainder of head dark brown; vertical tubercle not or scarcely developed; anterior vertex wide.

Thorax uniformly velvet black, almost glabrous. Halteres with stem dark brown, knob obscure yellow, weakly tipped with dusky. Legs with the coxæ velvety black; trochanters light brown; femora yellow, the tips narrowly black, the amount subequal on all legs and including about the distal sixth to eighth of the segment; tibiæ yellow, more obscure beyond base, the tip narrowly blackened; tarsi black. Wings (Plate 1, fig. 16) dark brown, the anal cells paler, especially at base; a handsome pattern of yellow and white; extreme wing base darkened; prearcular region and usually cell Sc yellow; cell C infuscated; an incomplete white crossband before cord, extending from vein R_1 to 1st A, just before the outer end of the latter; two small whitish spots in cells R_1 and M, respectively, the former crossing Rs into cell R; wing tip conspicuously white, involving cells R_3 to R_5, inclusive; veins dark, yellow in the pale areas. Costal fringe dense and abundant in both sexes; outer radial branches with relatively numerous trichia over most of their length; a few scattered trichia on outer section of vein M_{1+2}; other veins beyond cord glabrous. Venation: R_2 oblique, almost in transverse alignment with the unusually erect R_{2+3}; in the paratype female longer and even more oblique, at the fork of R_{2+3+4}; vein R_3 upcurved at tip; cell M_1 lacking; m-cu at near two-thirds to three-fourths the length of cell 1st M_2.

Abdomen with basal segment velvety black; tergites two to four pale yellow, with scarcely differentiated basal rings, these narrowly darkened in some individuals; tergites five and six velvety black, with broad, more-polished black basal rings; seventh tergite polished black; hypopygium black; sternites yellow, the incisures weakly darkened. In the female, segments two and three yellow, the remainder velvety black, with narrow glabrous basal rings on tergites four to six; genital shield heavily pruinose above, more reddish on ventral surface; cerci blackened basally, the remainder of the long valves dark horn-colored.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Tandjong Sakti, altitude 1,650 to 2,000 feet, June 1 to 10, 1935 (*Walsh*). Allotype, female, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*). Paratopotypes, 4 males, May 26 to July 19, 1935. Paratypes, 1 female, with the allotype; 1 male, Moeara Tenam, July 4 to 14, 1935 (*Walsh*).

By Edwards's key to the Old World species of the subgenus [12] the present fly runs to *Hexatoma* (*Eriocera*) *javensis* (Doleschall), which differs conspicuously in the pattern of the wings and abdomen. The silvery head of the present insect, while very conspicuous and distinctive, is likewise found in other allied forms.

HEXATOMA (ERIOCERA) VIDUA sp. nov. Plate 1, fig. 17.

Male.—Length, about 13 to 15 millimeters; wing, 8.5 to 10.

Very similar to *H.* (*E.*) *interstitialis* sp. nov., differing in the following regards: Antennæ of male 8-segmented; black throughout; third flagellar segment longer than the second, the others gradually decreasing in length outwardly. Entire vertex heavily light gray pruinose. Wings (Plate 1, fig. 17) with the white markings basad of the medial crossband larger but with very diffuse margins, the more basal involving cell M only; a distinct pale area in cell R_2 at near midlength; white apex very restricted, without yellow outer border, involving outer ends of cells R_3 and R_4. A few scattered macrotrichia on outer section of M_{1+2}. Venation: Sc_1 very short, extending only a short distance beyond R_2; m-cu at or shortly before outer end of cell 1st M_2. Abdomen more elongate, this probably a sexual character only; basal segment black; segments two to five, inclusive, bright yellow, with relatively narrow, black, caudal borders; succeeding segments and hypopygium black; no differentiated glabrous basal rings on segments.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Moeara Tenam, June 16 to 23, 1935 (*Walsh*). Paratopotype, male, July 4 to 14, 1935 (*Walsh*).

HEXATOMA (ERIOCERA) ATRISOMA sp. nov. Plate 1, fig. 18.

Body, together with antennæ, halteres and legs, black; wings strongly suffused with black, the anal cells more grayish; an incomplete white band before cord, together with two small, dirty white spots basad of the band; a narrow, nearly terminal

[12] Loc. cit.

white area; outer radial veins with numerous macrotrichia; Sc_2 in alignment with the slightly oblique R_2; R_{1+2} more than twice R_{2+3+4}; m-cu near outer end of cell 1st M_2.

Male.—Length, about 16 millimeters; wing, 12.

Rostrum and palpi black. Antennæ of male 8-segmented, black throughout; terminal segment a little longer than the penultimate. Head velvety black; vertical tubercle low and inconspicuous; a pale spot near center of posterior vertex, this possibly an abnormality of the type specimen; head with sparse black setæ.

Thorax uniformly deep velvety black; præscutal interspaces with sparse erect black setæ. Halteres black. Legs black, the tibiæ and tarsi a little less intensely so than the femora. Wings (Plate 1, fig. 18) strongly suffused with black, the anal cells conspicuously more grayish; a white pattern, arranged as follows: A narrow incomplete crossband before cord, extending from vein R_1 to midwidth of cell Cu; two small, obscure whitish spots basad of this band, one on Rs at near one-third the length, the other on vein M just before one-fourth the length; a white lunule, nearly apical, extending from vein R_3 to M_{1+2}, narrowly bordered outwardly by slightly paler brown; veins pale brown, a trifle lighter colored where traversing the white discal band. Macrotrichia on outer radial veins, more sparse and scattered on M_{1+2}. Venation: Sc_2 in alignment with the slightly oblique R_2; R_{1+2} more than twice R_{2+3+4}; cell M_1 lacking; m-cu near outer end of the short-rectangular cell 1st M_2.

Abdomen velvety black, the basal rings more glabrous but not differentiated in color; hypopygium deep black.

Habitat.—North Java.

Holotype, male, Tjolo, Goenoeng Moeria, altitude 2,100 feet, December 1 to 8, 1935 (*Walsh*).

By Edwards's key to the Old World species of the subgenus [13] the present form runs to couplet 105, where it disagrees conspicuously with both included forms by the intense black coloration of the body and appendages. If the pale lunule at wing tip is interpreted as being subapical, the fly runs to the common *Hexatoma* (*Eriocera*) *basilaris* (Wiedemann), which has the wing base broadly yellow, the white pattern of the wings more extensive and differently distributed, and the femoral bases broadly yellow. From other allied Sumatran species described at this time (*interstitialis, argyrocephala,* and *vidua*), the present

[13] Loc. cit.

fly differs in the uniform black coloration of the body and appendages and in the distinctive wing pattern.

HEXATOMA (ERIOCERA) SELENE (Osten Sacken).

Eriocera selene OSTEN SACKEN, Annali Mus. Civ. Genova 16 (1881) 406–407.

Eriocera selene EDWARDS, Bull. Raffles Mus. 7 (1932) 78–79.

Osten Sacken's type, a unique female, was from Goenoeng Singgalang, Sumatra, collected in July, 1878, by Beccari. Edwards recorded two additional males from Siberut Island, Mentawi Islands, west of Sumatra.

Several males and females from different stations in Benkoelen, southeastern Sumatra. Tandjong Sakti, altitude 1,650 to 2,000 feet, July 19, 1935. Moeara Tenam, June 16 to July 14, 1935 (*Walsh*).

The above specimens may be redefined as follows:

Male.—Length, 15 to 17 millimeters; wing, 13 to 15.5.

Female.—Length, 15 millimeters; wing, 12.

The coloration of the thorax varies in different specimens from reddish orange to deep cherry red. Vestiture of head and præscutum relatively sparse but long and conspicuous. Vertical tubercle simple. Antennæ of male 8-segmented, of female 10-segmented; basal flagellar segments yellow, the terminal two (male) to four (female) darkened.

Legs brownish black, the femoral bases restrictedly yellow; tarsi black. Wings dark brown, with two white areas, one before the cord, extending from vein R_1 nearly to Cu, nearly straight to weakly crescentic in outline; second spot at wing tip, involving the outer ends of cells R_3 and R_4; in all specimens before me this latter area is apical in position. A pale streak in cell 1st A, adjoining the basal half of the vein. As stated by Edwards, Rs is unusually short, not exceeding twice the length of R_{2+3+4}, and only a little longer than R_{1+2}; Sc_1 ends before, opposite, or even shortly beyond the transverse R_2; m-cu at from one-third to one-fourth its length before the fork of M_{3+4}. One specimen shows an abnormal venation in having an adventitious crossvein in cell R_3 of one wing and with m obliterated or nearly so by the shortening and approximation of veins M_{1+2} and M_3, the point of union being surrounded by a pale spot.

Abdomen polished black, the caudal margins of the tergites very narrowly velvet black, the amount of the latter decreasing on the outer segments, tergites one, seven, and eight entirely

black. Sternites beyond the basal two velvety black, with narrow glabrous basal rings; hypopygium and genital shield of female black. Osten Sacken's unique type had the latter area reddish.

HEXATOMA (ERIOCERA) SEMILUNATA sp. nov. Plate 1, fig. 19.

General coloration black; antennæ (male) 8-segmented; legs dark brown, the terminal tarsal segments blackened; wings with a strong brown suffusion; prearcular field broadly light yellow; a narrow whitish crossband before cord; wing tip narrowly paler brown than the ground, bordered internally by a very narrow whitish lunule; relatively numerous macrotrichia on outer radial veins; Sc_2 some distance before tip of Sc_1 and before inner end of the oblique R_2; abdomen black, the basal rings broadly glabrous and slightly nacreous.

Male.—Length, about 14 millimeters; wing, 12.5.

Rostrum and palpi black. Antennæ of male 8-segmented; scape black, pruinose; remainder of organ black; terminal segment longer than the penultimate. Head black, silvery pruinose, especially on front and anterior vertex, the color extended into a triangular point behind; vertical tubercle scarcely developed; setæ black, conspicuous.

Thorax velvety black, almost glabrous. Halteres black. Legs with the coxæ and trochanters black; remainder of legs dark brown, the terminal tarsal segments blackened. Wings (Plate 1, fig. 19) with a strong brown suffusion; prearcular field broadly light yellow but the extreme base darkened; a narrow, parallel-sided whitish crossband before cord, extending from vein R almost to 1st A; wing tip narrowly paler brown than the ground, with an extremely narrow, internal, whitish lunule; veins pale brown, lighter colored in the pale areas. Relatively numerous macrotrichia on outer radial veins, these fewer and more scattered on the outer medial branches. Venation: Sc_2 some distance before tip of Sc_1 and before the inner end of the oblique R_2; R_{1+2} nearly twice R_{2+3+4}; m-cu near outer end of cell 1st M_2.

Abdomen black, the basal rings very broadly polished to weakly nacreous, on tergites two and three the apical ring subequal in width to the basal; on outer segments, the velvety apices of the tergites becoming progressively narrower, greatly narrowed on the seventh segment; basal rings of more proximal segments glabrous, segments six and seven with numerous scattered setæ; hypopygium black.

Habitat.—East Java.

Holotype, male, Djoenggo, Mount Ardjano, altitude 4,500 feet, January, 1936 (*Walsh*).

In its general appearance, the present fly somewhat resembles *Hexatoma* (*Eriocera*) *malangensis* Alexander and *H.* (*E.*) *salakensis* (Edwards), differing especially in the nearly apical white lunule of the wings. Both of the species mentioned have the trichia of the wing veins much more restricted and scattered, being actually or nearly lacking on vein R_3 and on the outer medial branches.

HEXATOMA (ERIOCERA) ATRICORNIS Alexander.

Hexatoma (*Eriocera*) *atricornis* ALEXANDER, Philip. Journ. Sci. 54 (1934) 457–458.

One female, Soekaboemi, West Java, altitude 1,800 feet, February 1934 (*Walsh*).

HEXATOMA (ERIOCERA) TOXOPEI sp. nov. Plate 1, fig. 20.

General coloration black; legs brownish black, the femoral bases obscure yellow; wings brownish black, the base conspicuously light yellow; a relatively narrow white crossband before cord; scattered trichia on outer ends of veins R_4, R_5, and M_{1+2}; Rs about four times the basal section of R_5; cell 1st M_2 relatively small, vein M_{1+2} being more than twice the length of the cell; m-cu at midlength of cell 1st M_2; abdominal tergites black, glabrous on basal portions.

Male.—Length, about 14 millimeters; wing, 11.5.

Rostrum and palpi black. Antennæ of male 8-segmented; scape and pedicel brownish black; flagellum brown. Front and anterior vertex heavily pruinose; posterior portion of head black, with relatively conspicuous black setæ.

Thorax black, nearly glabrous. Halteres black. Legs with the coxæ and trochanters black; femora black, the bases broadly obscure yellow, including about the basal third on forelegs and nearly the outer half on the posterior pair, the yellow gradually passing into the dark color; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 20) brownish black, the base conspicuously light yellow to the level of the arculus; a relatively narrow white crossband before cord, extending from vein R_1 across cells R_1, R, and M, barely invading cell Cu behind; veins dark brown, paler in the brightened areas. Trichia present on veins R_4, R_5, and M_{1+2}, scattered and restricted to the outer ends of veins; veins R_3, M_3, and M_4 without trichia. Venation: Sc_1

ending just beyond R_2, Sc_2 a short distance from its tip; R_2 only moderately oblique; R_{2+3+4} about one-half R_{1+2}; Rs about four times the basal section of R_5; cell 1st M_2 relatively small, the veins beyond it long, M_{1+2} being more than twice the length of the cell; m-cu at near midlength of cell 1st M_2.

Abdomen, including hypopygium, black, the bases of all but the eighth tergite glabrous, but not at all pruinose or whitened, the amount of glabrosity greatest on the more basal segments, becoming less on the outer segments, reaching a minimum on segments seven and eight.

Habitat.—Central Java.

Holotype, male, Goenoeng Soembing, near Kledong, altitude 5,850 feet, May 21, 1933 (*Toxopeus*); through Mrs. M. E. Walsh.

I am pleased to name this species in honor of the collector, Mr. L. J. Toxopeus. In its general appearance and wing pattern, the fly is somewhat similar to *Hexatoma* (*Eriocera*) *malangensis* Alexander and *H.* (*E.*) *salakensis* (Edwards), both of Java, especially to the former. This has the pattern of the legs and wings distinct and the venational details quite different, as the even more oblique R_2, relatively short Rs, which is not more than three times the basal section of R_5, and the different arrangement of veins in the outer medial field. *Hexatoma salakensis* has the abdomen chiefly yellow and the venational details very distinct, having R_2 exceedingly oblique and Rs unusually short, less than two times the length of the basal section of R_2, in this respect being exceeded only by *H.* (*E.*) *selene* (Osten Sacken) among the local species. The wing venation of the present fly is much as in *H.* (*E.*) *diengensis* Alexander, but the coloration of the body, especially of the abdomen, is different. It seems probable that *diengensis* will prove to be the closest ally of the present fly.

HEXATOMA (ERIOCERA) CINGULATA (de Meijere).

Eriocera cingulata DE MEIJERE, Tijd. voor Ent. 54 (1911) 58–59.
Eriocera fasciata DE MEIJERE, Tijd. voor Ent. 54 (1911) 59 (name preoccupied by Guérin and Williston).

SOUTH SUMATRA, Boekit Jtam, Benkoelen, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*). Moeara Tenam, Benkoelen, June 16 to 23, 1935 (*Walsh*).

WEST JAVA, Goenoeng Malang, Djampangs, altitude 3,000 feet, July 10, 1933 (*Walsh*). Soekaboemi, altitude 1,800 feet, April 15, 1933 (*Walsh*).

HEXATOMA (ERIOCERA) CONSTRICTA Alexander.

Hexatoma (*Eriocera*) *bengalensis constricta* ALEXANDER, Philip. Journ. Sci. 54 (1934) 459–460.

Further material and the study of rather numerous specimens have convinced me that the East Indian species commonly identified as being *Hexatoma* (*Eriocera*) *bicolor* (Macquart) cannot be the same as the last-named species, the type specimen of which was from Bengal. The synonymy of *bicolor* (*bengalensis*) is given in the paper cited above, and I consider that this species as now restricted is known only from British India.

The second species, widely distributed in Sumatra, Java, and Borneo, may be considered to be a variety of *constricta* Alexander, the typical form of which I have seen only from West Java. To the more widespread form of the species, having the costal border of the wings broadly yellow, connecting the yellow discal fascia with the prearcular area, I give the name *Hexatoma constricta sunda* subsp. nov.

HEXATOMA CONSTRICTA SUNDA subsp. nov.

Holotype, male, Moeara Tenam, Benkoelen, Sumatra, June 16 to 23, 1935 (*Walsh*). Allotype, female, Tandjong Sakti, Benkoelen, Sumatra, altitude 1,650 to 2,000 feet, July 16 to 19, 1935 (*Walsh*). Paratypes, female, Harau Kloof, West Sumatra, altitude 1,790 feet, June, 1926 (*Jacobson*); male, Borneo, 1891 (*Chaper*).

HEXATOMA (ERIOCERA) LUNIGERA (Walker).

Pterocosmus lunigera WALKER, Proc. Linn. Soc. London 1 (1857) 107.

WEST JAVA, Djampangs, Tengah, altitude 1,500 to 2,000 feet, March, June, 1933 (*Walsh*). Selabintanah, Mount Gedeh, altitude 3,000 feet, December, 1932 (*Walsh*).

HEXATOMA (ERIOCERA) SUBLUNIGERA sp. nov. Plate 1, fig. 21.

Allied to *lunigera;* coloration deep velvety black, the præscutum with three highly polished black stripes; legs and halteres black, the femoral bases more brightened, especially the fore pair; wings dark brown, with a narrow broken whitish band before cord and a tiny yellow spot at extreme outer end of cell R_4; abdomen, including genital shield of female, intense black.

Male.—Length, about 13 millimeters; wing 10.

Female.—Length, about 18 millimeters; wing, 13.

Rostrum and palpi black. Antennæ 8-segmented in both sexes; scape black; pedicel brownish black; flagellum dark

brown; terminal segment longer than the penultimate. Head deep velvety black, the anterior vertex very vaguely pruinose; vertical tubercle low and inconspicuous; setæ of head black, sparse but conspicuous.

Pronotum velvety black. Mesonotal præscutum velvety black, with three highly polished black stripes; setæ of interspaces black, sparse and erect; posterior sclerites of mesonotum velvety black. Pleura velvety black, almost glabrous. Halteres black. Legs black, the bases of the fore femora obscure yellow, involving about the proximal third, the bases of the middle and hind femora dark brown. Wings (Plate 1, fig. 21) almost uniformly dark brown, the anal cells more grayish, except at apex of cell 1st A and along vein 2d A; a very restricted broken dirty-white band before cord, occurring in outer ends of cells R and M just before fork of M and as an isolated spot in cell R_1, immediately beneath Sc_2; extreme wing tip in apex of cell R_4 very restrictedly yellow; veins dark brown. In the female an additional pale spot near center of cell M_4. Abundant macrotrichia on all outer radial veins, more scattered on distal sections of outer medial veins; vein 1st A with scattered trichia for almost its entire length; veins Cu and 2d A glabrous. Venation: Sc_1 ending opposite or just beyond the fork of R_{2+3+4}, far before R_2; R_{1+2} shorter than R_{2+3+4}; cell 1st M_2 approximately as long as the longest veins issuing from it, with m-cu at or beyond three-fourths the length of the cell.

Abdomen deep velvety black, the segments with the basal rings more glabrous but only feebly differentiated from the remainder, concolorous; hypopygium black. Genital segment of female deep velvety black; cerci black at bases, the outer ends passing into brown.

Habitat.—East Java.

Holotype, male, Nongkodjadjar, Tengger Mountains, altitude 3,600 feet, February, 1936 (*Walsh*). Allotopotype, female.

The nearest ally of the present fly is *Hexatoma* (*Eriocera*) *lunigera* (Walker), which has similar highly polished præscutal stripes. The species here described is readily told by the restricted broken white band before the cord of wing, and the reduction of the yellow apical lunule to a tiny brightening at extreme outer end of cell R_4. The black, instead of orange, genital shield of the female, is very conspicuous. In addition, the præscutal stripes of this fly are black instead of blue-black, as is the case in *lunigera*.

ERIOPTERINI

TRENTEPOHLIA (PLESIOMONGOMA) SUBCANDIDIPES sp. nov. Plate 1, fig. 22.

Allied to *candidipes;* size large (wing, male, 9 millimeters); mesonotal præscutum and the pleura uniformly orange-yellow, unmarked; femora yellow, passing into dark brown towards outer ends, the tips abruptly white; tibiæ and tarsi white; wings relatively narrow, subhyaline, the tip narrowly but distinctly infumed; cord and vein R_5 very narrowly seamed with dusky; abdomen yellow, the tergite with an entire black median stripe, the outer two segments entirely black.

Male.—Length, about 12 millimeters; wing, 9.

Rostrum dark brown; palpi brownish black. Antennæ pale brown, relatively elongate, if bent backward ending a short distance before the wing root; flagellar segments cylindrical, with the incisures poorly evident; verticils shorter than the segments. Head light gray, the posterior vertex darker on either side of the median line; anterior vertex narrow, carinate.

Cervical sclerites brownish black. Pronotum and mesonotal præscutum entirely orange-yellow, unmarked; scutal lobes darkened, the remainder of scutum pale; scutellum and postnotum chiefly darkened. Pleura and pleurotergite uniformly orange-yellow. Halteres black, the base of stem restrictedly pale yellow. Legs elongate; coxæ and trochanters yellow; femora yellow basally, passing into dark brown on the outer fourth or fifth, the tips abruptly and rather broadly (2 millimeters) snowy white, the amount subequal on all legs; tibiæ and tarsi white, the fore and middle tarsi slightly more darkened on subbasal portion to produce a dirty white appearance; all femora with scattered erect setæ distributed throughout their length. Wings (Plate 1, fig. 22) relatively narrow, subhyaline; prearcular region and cells C and Sc very slightly more yellowish; stigma small, triangular, dark brown; wing tip narrowly and weakly infumed; origin of Rs, R_2, cord, and vein R_5 very narrowly seamed with dusky; veins black, paler in the brightened costal portion. Venation: Rs subequal to R_{2+3+4}.

Abdomen elongate; tergites yellow, with a relatively broad, continuous, black, median stripe; sternites uniformly yellow; eighth and ninth segments uniformly black.

Habitat.—North Java.

Holotype, male, Tjolo, Goenoeng Moeria, altitude 2,100 feet, December 8, 1935 (*Walsh*).

The only allied described species is *Trentepohlia* (*Plesiomongoma*) *candidipes* Edwards (Malay Peninsula: Selangor), which differs especially in the small size, heavily patterned mesonotal præscutum, undarkened wing tip, and distinct abdominal coloration.

Genus GONOMYIA Meigen

Gonomyia MEIGEN, Syst. Beschr. zweifl. Ins. 1 (1818) 146.

Considerable confusion has arisen in the subgeneric classification of certain of the more generalized species of the vast genus *Gonomyia*. Until recently, all such groups had been placed in *Progonomyia* Alexander, but it now seems advisable to recognize three subgeneric groups within this particular complex of forms. These subgenera may be separated as follows:

1. Vein R_2 preserved .... *Progonomyia* Alexander.
   Vein R_2 atrophied .... 2.
2. Ovipositor with elongate sclerotized valves........ *Ellipteroides* Becker.
   Ovipositor with short fleshy valves........ *Protogonomyia* Alexander.

Subgenus PROGONOMYIA Alexander

Gonomyella ALEXANDER, Ann. South African Mus. 17 (1917) 152, preoccupied.

Progonomyia ALEXANDER, Cornell Univ. Mem. 38 (1920) 938, renaming of last.

Type of subgenus: *Gonomyia* (*Progonomyia*) *slossonæ* Alexander (southern Nearctic; Neotropical).

There are more than a score of described species in the Neotropics, together with the following species restricted to South Africa: *Gonomyia* (*Progonomyia*) *brevifurca* Alexander; *G.* (*P.*) *flaveola* Alexander; *G.* (*P.*) *natalensis* Alexander; *G.* (*P.*) *nigrobimbo* Alexander; *G.* (*P.*) *pulchrissima* Alexander.

Subgenus ELLIPTEROIDES Becker

Ellipteroides BECKER, Zeitschr. für. Syst. Hym. und Dipt. 7 (1907) 239.

Type of subgenus: *Gonomyia* (*Ellipteroides*) *picea* (Becker) (southern Palæarctic: Tunis).

All included species are Palæarctic and Oriental in distribution. Besides the subgenotype, the following are included.

Western Palæarctic: *Gonomyia* (*Ellipteroides*) *alboscutellata* (Röser), synonyms *limbata* Röser, *scutellata* Egger; *G.* (*E.*) *lateralis* (Macquart), synonyms *cincta* Egger, *manifesta* Walker. It seems somewhat questionable to me whether *picea* can be

maintained as distinct from *lateralis*. On the other hand, the often overlooked *G.* (*E.*) *atra* Huguenin [14] appears to be distinct from *alboscutellata*.

Oriental: *Gonomyia* (*Ellipteroides*) *atropolita* sp. nov.; *G.* (*E.*) *tenebrosa* Edwards; *G.* (*E.*) *terebrella* Alexander.

Gonomyia (*E.*) *brunnescens* Edwards (Borneo), still known only from the male sex, probably belongs here but may fall in the subgenus *Protogonomyia*.

Subgenus PROTOGONOMYIA Alexander

Protogonomyia ALEXANDER, Philip. Journ. Sci. 55 (1934) 52–53.

Type of subgenus: *Gonomyia* (*Protogonomyia*) *confluenta* Alexander (Oriental: Formosa).

All included species are eastern Palæarctic and Oriental. Besides the subgenotype, these are: *Gonomyia* (*Protogonomyia*) *clitellata* Alexander; *G.* (*P.*) *lenis* sp. nov.; *G.* (*P.*) *nigripes* (Brunetti), synonyms *gracilis* Brunetti, *incompleta* Brunetti, *nigra* Brunetti; *G.* (*P.*) *perturbata* Alexander; *G.* (*P.*) *scutellum-album* Alexander.

GONOMYIA (ELLIPTEROIDES) ATROPOLITA sp. nov. Plate 1, fig. 23.

General coloration black, the three præscutal stripes and centers of scutal lobes intensely polished, the remainder of thorax chiefly with a sparse pruinosity; scutellum with posterior border narrowly brownish yellow; head brown, the center of vertex brownish black; halteres blackened; femora brownish yellow, the apex on outer face narrowly blackened; wings subhyaline; stigma long-oval, darker brown; veins dark brown, heavy and conspicuous.

Female.—Length, about 6 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ with scape and pedicel yellow, flagellum black; flagellar segments oval, with verticils that exceed the segments in length. Head brown, the center of vertex brownish black, the surface dull.

Pronotum black laterally, obscure yellow medially; anterior lateral pretergites yellow. Mesonotal præscutum intense black, the three usual stripes polished, the interspaces sparsely and vaguely pruinose; humeral region of præscutum very restrictedly brightened; scutum black, the centers of the lobes more polished, the median area more pruinose; scutellum blackened, the posterior margin narrowly and obscurely brownish yellow, the surface sparsely pruinose; mediotergite black, the surface with

[14] Dipt. Helvetiæ (1880) 50, couplet 5.

a sparse pruinosity. Pleura dull black, vaguely marked with paler on the pteropleurite; dorsopleural membrane light yellow. Halteres blackened. Legs with the coxæ brown, more darkened basally; trochanters obscure yellow; femora brownish yellow, the apex on outer face restrictedly darkened; tibiæ and tarsi yellowish brown to brown, the outer tarsal segments passing into brownish black; legs conspicuously hairy. Wings (Plate 1, fig. 23) subhyaline or with a barely indicated brownish tinge; stigma distinct, long-oval, darker brown; a scarcely evident darkening on anterior cord; veins dark brown, heavy and conspicuous. Venation: Sc_1 ending about opposite two-thirds the length of Rs, Sc_2 at near one-fifth this length; cell R_2 relatively wide at margin, subequal to R_5; cell 2d M_2 slightly exceeding twice its petiole; m-cu at fork of M.

Abdomen black, the surface weakly pruinose; cerci elongate, horn-yellow.

Habitat.—West Java.

Holotype, female, Tjibōrōm, altitude 4,000 feet, September 20, 1935 (*Walsh*).

The nearest ally of the present fly is *Gonomyia* (*Ellipteroides*) *tenebrosa* Edwards, of peninsular Siam, which has the legs dark brown, the wings brownish tinged and without a stigmal darkening. In the present fly vein R_{2+3+4} is less than one-half R_3 and m-cu is at the exact fork of M.

GONOMYIA (PROTOGONOMYIA) LENIS sp. nov. Plate 1, fig. 24.

Size small (wing, female, 5 millimeters); general coloration of mesonotum brown, without clearly defined darker markings; legs, including tarsi, pale brown; wings very slightly tinged with brown, the prearcular and costal portions a little more yellowish; Sc long, Sc_1 ending shortly before the fork of Rs; anterior branch of Rs lying close to vein R_{1+2}, cell R_2 narrow at margin; abdominal tergites dark brown, the sternites obscure yellow.

Female.—Length, about 5 millimeters; wing, 5.

Rostrum yellow; palpi long and conspicuous, brownish black. Antennæ with scape and pedicel yellow, flagellum black; organ relatively long, if bent backward nearly attaining the wing root; flagellar segments long-oval, the verticils about as long as the segments. Head dark brown.

Cervical region brown, relatively long. Pronotum pale medially, more blackened on sides. Mesonotal præscutum brown, without clearly defined darker markings; scutellum obscure yel-

low. Pleura infuscated on dorsal portions, more yellowish ventrally. Halteres dark brown, the basal portion of stem obscure yellow. Legs with the coxæ and trochanters yellow; remainder of legs pale brown, including all tarsal segments. Wings (Plate 1, fig. 24) with a very slight brown tinge, the prearcular and costal portions a little more yellowish; veins delicate, pale brown, more yellowish in the costal and basal portions. Venation: Sc long, Sc_1 ending shortly before fork of Rs, Sc_2 far from its tip, just before one-third the length of Rs; anterior branch of Rs lying close to R_{1+2}, cell R_2 at margin narrow; cell 2d M_2 deep, its petiole subequal to m-cu, the latter at or just before fork of M.

Abdominal tergites dark brown, sternites and pleural membrane obscure yellow. Ovipositor with very short fleshy valves, as in the subgenus; hypovalvæ obtusely rounded at tips.

Habitat.—West Java.

Holotype, female, Bodjang Kalang, Djampangs, September, 1935 (*Walsh*).

The most similar species is *Gonomyia* (*Protogonomyia*) *clitellata* Alexander, of Formosa, which differs in all details of coloration and venation, as the short Sc, nearly straight unbowed Rs, and the short cell 2d M_2. The present fly differs from all described members of the subgenus in the more-arched anterior branch of Rs, which thus lies unusually close to vein R_{1+2}, so that cell R_2 at margin is unusually narrow.

ILLUSTRATIONS

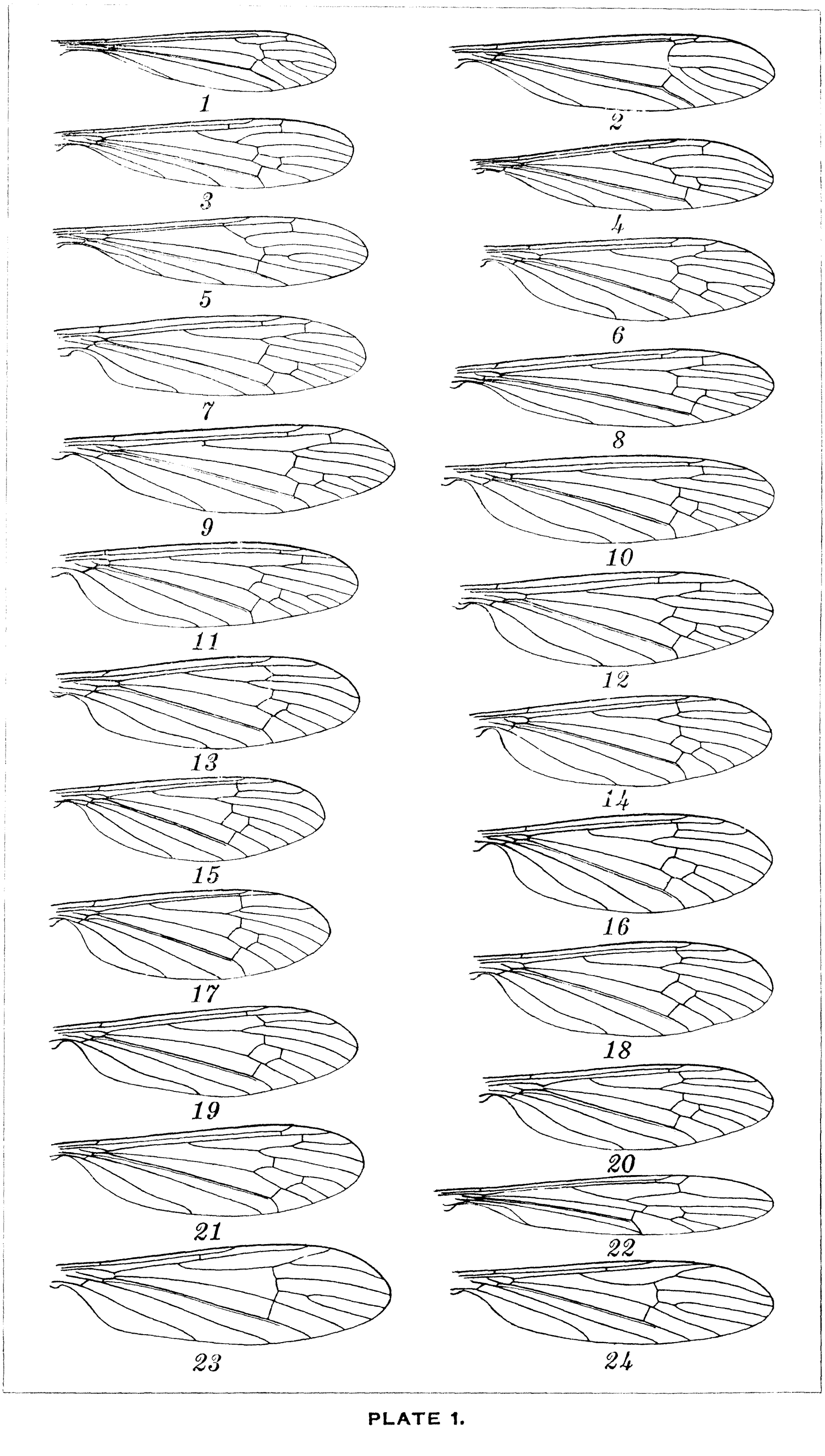

PLATE 1.

DIPLOSENTIS AMPHACANTHI GEN. ET SP. NOV., AN ACANTHOCEPHALA PARASITIC IN A MARINE FISH

By MARCOS A. TUBANGUI and VICTORIA A. MASILUÑGAN
Of the Bureau of Science, Manila

ONE PLATE AND TWO TEXT FIGURES

DIPLOSENTIS AMPHACANTHI gen. et sp. nov.

Numerous specimens of this interesting proboscis roundworm were found in the intestine of a fish, *Amphacanthus oramin*, caught in Mucilagos Bay, northern Mindanao. We wish to thank Dr. Hilario A. Roxas, chief of the Fish and Game Administration of the Bureau of Science, for kindly placing the material at our disposal.

The parasite has two morphological features that separate it from all previously recorded Acanthocephala; namely, (*a*) coiled lemnisci inclosed in a membranous sac and (*b*) two elongated tubular prostatic glands. According to the available literature, only *Cleaveius circumspinifer* Subrahmanian, 1927, approaches the Philippine parasite in the possession of much coiled lemnisci, but it differs from the latter in the presence of cuticular spines on its anterior body region and in the number and shape of its prostatic glands. With regard to the latter structures, only *Acanthogyrus acanthogyrus* Thapar, 1927, has previously been reported as possessing two cement glands, all other known acanthocephalans, according to Southwell and Macfie (1925), having either a syncytial mass or at least three prostatic glands. The Philippine species, however, may be distinguished from *A. acanthogyrus* by the form of its lemnisci, its unarmed cuticle, the shape of its proboscis and the number and shape of the proboscis hooks. For these reasons it has been found necessary to propose for it a new genus.

Generic diagnosis.—Cuticle unarmed. Proboscis club-shaped, with simple hooks. Proboscis sheath double-walled, with brain and retinacula in front of middle of its length. Lemnisci much coiled, inclosed in a membranous sac. Male genital organs in posterior two-thirds or three-fourths of body length. Cement

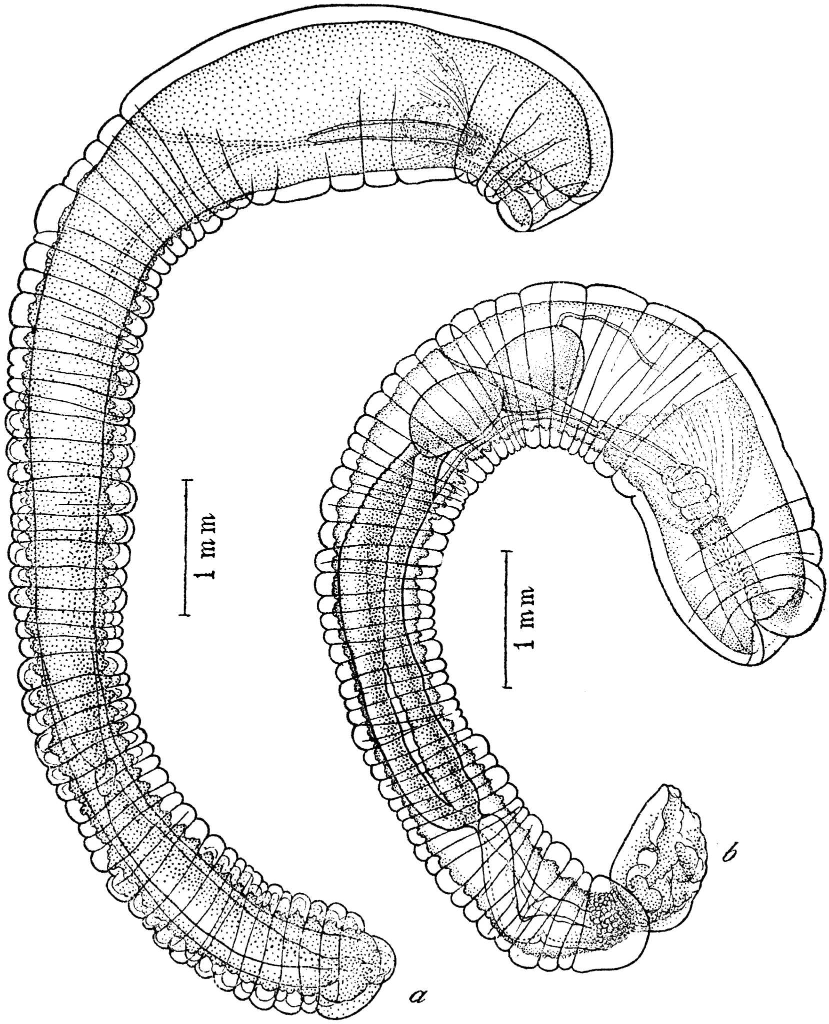

FIG. 1. *Diplosentis amphacanthi* gen. et sp. nov.; *a*, adult female, lateral view; *b*, adult male, lateral view.

glands two, elongate and tubular. Eggs with three membranes, the middle one with polar prolongations. Parasitic in fishes.

Type species.—Diplosentis amphacanthi sp. nov.

Description of type species.—Body devoid of spines, slightly swollen anteriorly and presenting pseudoannulation due to folding of cuticle. Body wall 95 to 135 microns in maximum thickness. Male smaller than female, 3 to 7 millimeters in length by

0.70 to 1.15 millimeters in maximum dorsoventral diameter. Female measures 10 to 18 by 0.85 to 1.20 millimeters.

Proboscis club-shaped, measuring, when fully extended, 0.42 to 0.46 millimeter in length by 0.12 to 0.17 millimeter in maximum diameter. It is armed with 12 longitudinal rows of hooks, each row with 8 to 9 hooks, measuring, except those of the last row, 38.5 to 42 microns in length; hooks of posterior row 19 to 26.5 microns long.

Neck absent.

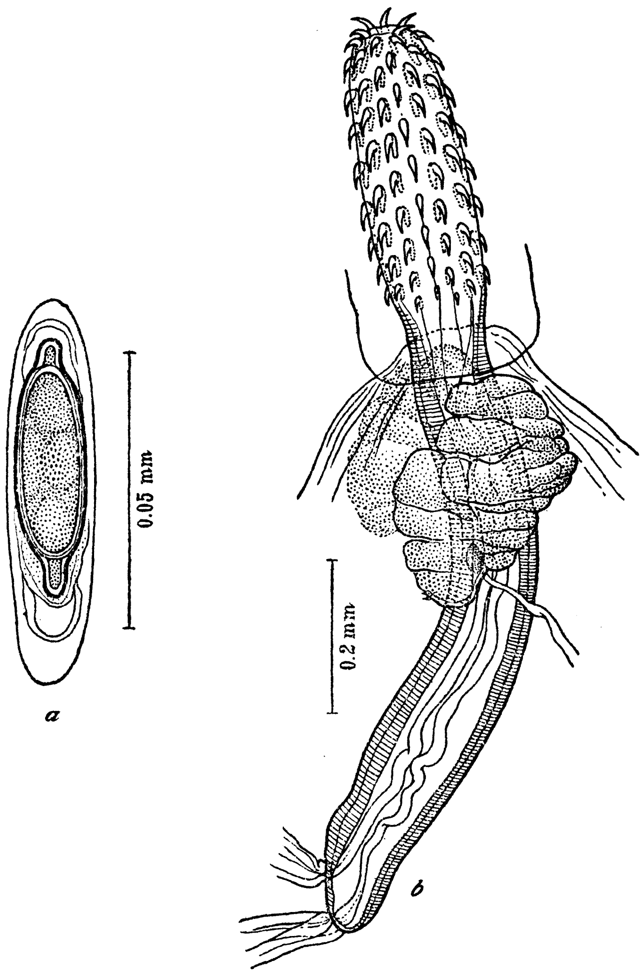

FIG. 2. *Diplosentis amphaeanthi* gen. et sp. nov.; *a*, egg; *b*, proboscis, proboscis sheath, and lemnisci, enlarged.

Proboscis sheath double-walled, 0.65 to 1.2 millimeters by 0.11 to 0.23 millimeter in size. Nerve ganglion and retinacula immediately in front of middle of length of proboscis sheath.

Lemnisci in the form of a pair of coiled masses, extending posteriorly to near middle of length of proboscis sheath; each mass appears inclosed in a membranous sac.

Testes subglobular to oval, one in front of the other and usually touching, situated in front of middle of body length. Anterior testis slightly larger than posterior testis, the former measuring 0.45 to 0.60 by 0.20 to 0.28, and the latter 0.38 to 0.52 by 0.19 to 0.28 millimeter.

Prostatic or cement glands two, tubular, 1.3 to 3.0 millimeters in length (Plate 1). Cement reservoir 0.5 to 1.3 by 0.14 to 0.36 millimeters in size. Bursa well developed.

Eggs numerous, free in body cavity of gravid females, measuring 51.8 to 78.7 by 15.3 to 18.0 microns. They possess three membranes, the middle one of which is the thickest and has two polar prolongations.

Chief longitudinal vessels of subcuticula lateral.

Host.—*Amphacanthus oramin* Bloch and Schneider.

Location.—Intestine.

Locality.—Mucilagos Bay, Mindanao.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 504.

SYSTEMATIC POSITION

The place of *Diplosentis amphacanthi* in the major classification of the Acanthocephala is undoubtedly in the order Palæacanthocephala Meyer, 1931, as emended by Van Cleave (1936), due to the lateral position of the main longitudinal vessels in its subcuticula, the limited number of prostatic glands, the absence of giant subcuticular nuclei and protonephridial organs, and the quincunxial arrangement of the proboscis hooks. It does not fit, however, in any of the families included in that order, for which reason the new family Diplosentidæ, with the characters of the genus *Diplosentis,* as given above, is hereby proposed for it.

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ILLUSTRATIONS

Plate 1

Diplosentis amphacanthi gen. et sp. nov. Cross section through posterior end of male showing the two prostatic glands.

TEXT FIGURES

FIG. 1. *Diplosentis amphacanthi* gen. et sp. nov.; *a,* adult female, lateral view; *b*, adult male, lateral view.

2. *Diplosentis amphacanthi* gen. et sp. nov.,; *a,* egg; *b,* proboscis, proboscis sheath, and lemnisci, enlarged.

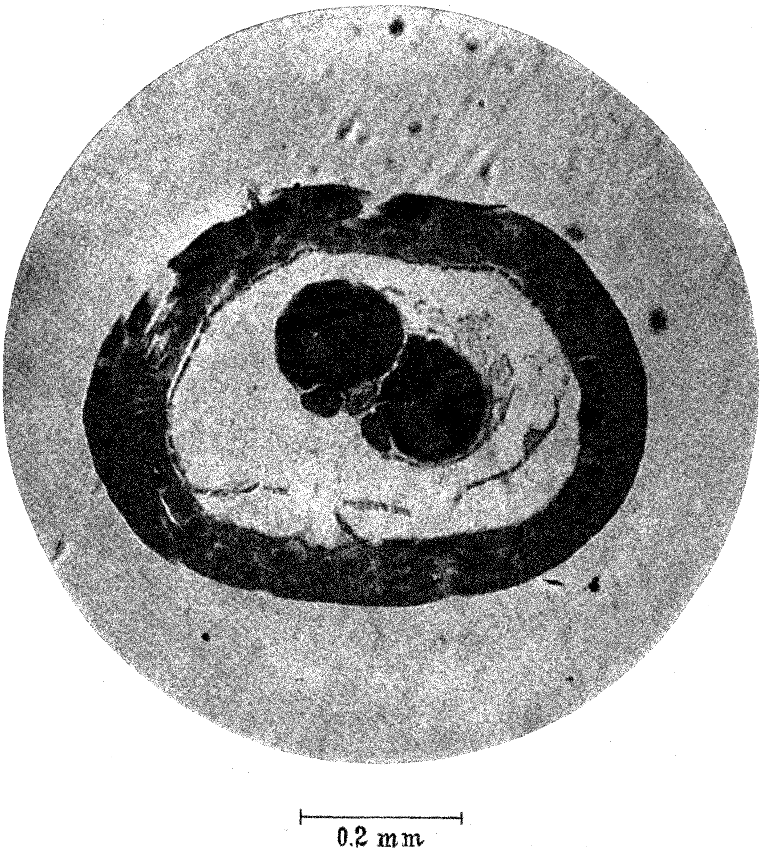

PLATE 1.

DIATOMS FROM IKEDA LAKE, SATSUMA PROVINCE KIUSIU ISLAND, NIPPON

By B. W. SKVORTZOW
Of Harbin, Manchoukuo

FOUR PLATES

So far as I know, no account of fresh-water diatoms of Ikeda Lake, Nippon, has been published, and the present note thus affords the first available data on this subject. In 1928 I received from Prof. Dr. T. Kawamura, director of the Zoölogical Institute, College of Science, Kyoto Imperial University, a diatom sample from Ikeda Lake, Satsuma Province, Kiusiu Island, from the southern part of Nippon, collected by Dr. T. Kawamura in January, 1923. According to Dr. M. Ueno, Ikeda Lake is near the town of Kagoshima, 31° 94′ north latitude, at an altitude of 66 feet, with an area of 10.98 square kilometers and a maximum depth of 233 meters. The plankton of this lake is very scarce. The diatom flora of Ikeda is quite rich and 157 forms are here enumerated. I have some reason for believing that future researches may considerably increase the number of species known to live in Ikeda Lake. Several forms, of frequent occurrence in Aokiko, Kizaki, and Biwa Lakes, are also common in Ikeda samples. The diatoms from Ikeda are freshwater forms. The following species, characteristic of brackish water, were also found: *Mastogloia elliptica* var. *dansei*, *Navicula halophila* var., *Rhopalodia gibberula* var. *Van Heurcki*, *Nitzschia tryblionella* var. *debilis* and var. *Victoriæ*, *N. Clausii*, and *N. frustulum* var. *perpusilla*. Almost all the new species and varieties of diatoms found in Ikeda Lake are named in honor of the late K. Okamura, of Tokyo, the great Nipponese algologist, who died August 21, 1935.

MELOSIRA ITALICA (Ehr.) Kütz. var. VALIDA Grun.

Melosira italica (Ehr.) Kütz. var. *valida* Grun., FR. HUSTEDT, Bacillar. (1930) 91, fig. 51.

A diatom with robust frustules, ornamented with coarse puncta and end spines. Rare. Known from Aokiko and Kizaki Lakes.

MELOSIRA ISLANDICA O. Müll. subsp. HELVETICA O. Müll. Plate 2, fig. 13.

Melosira islandica O. Müll. subsp. *helvetica* O. Müll., FR. HUSTEDT, Bacillar. (1930) 89, fig. 48.

Frustule 0.006 to 0.008 mm in breadth, with parallel rows of puncta. Rows of puncta 18, puncta 15 in 0.01 mm. The frustules of Nipponese specimens are similar to those of the European. New to Nippon.

MELOSIRA AMBIGUA (Grun.) O. Müll. status y.

Melosira ambigua (Grun.) O. Müll. *status y*, FR. HUSTEDT, Bacillar. (1930) 91.

A form with fine striæ. Frustule length, 0.017 mm; breadth, 0.0085. Rare. A fresh-water species.

MELOSIRA UNDULATA (Ehr.) Kütz.

Melosira undulata (Ehr.) Kütz., A. SCHMIDT, Atlas Diatom. (1892) pl. 180, figs. 1–14, 16–19, 21.

A robust species with thick frustules. Diameter, 0.054 mm. Common in tropical districts. Known from Aokiko, Kizaki, and Biwa Lakes.

CYCLOTELLA COMTA (Ehr.) Kütz.

Cyclotella comta (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 103, fig. 69.

Valve circular; a central-area marking of minute beads, regularly decreasing to the border; about one-third of border strongly marked with radial striæ. Diameter of the valve, 0.01 to 0.014 mm. Striæ 15 in 0.01 mm. Common. Known from Kizaki and Biwa Lakes.

CYCLOTELLA STELLIGERA Cleve and Grun.

Cyclotella stelligera Cleve and Grun., FR. HUSTEDT, Bacillar. (1930) 100, fig. 65.

A minute species with a central-area marking of radiate stellate striæ. Diameter of the valves, 0.0065 to 0.007 mm. Reported from Kizaki Lake.

CYCLOTELLA MENEGHINIANA Kütz.

Cyclotella meneghiniana Kütz., FR. HUSTEDT, Bacillar. (1930) 100, fig. 67.

Valve circular with a hyaline central area. Diameter of the valve, 0.0051 to 0.007 mm. Differs from the type in being smaller.

STEPHANODISCUS CARCONENSIS Grun. var. PUSILLA Grun.

Stephanodiscus carconensis Grun. var. *pusilla* Grun., A. SCHMIDT, Atlas Diatom. (1901) pl. 228, figs. 11, 12; SKVORTZOW, Diatoms Biwa Lake (1936) pl. 1, figs. 8, 9, 11, 14, and 18.

Diameter of the valves, 0.027 to 0.03 mm. Rare in Ikeda and very common in Biwa Lake.

TABELLARIA FENESTRATA (Lyngb.) Kütz.

Tabellaria fenestrata (Lyngb.) Kütz., FR. HUSTEDT, Bacillar. (1930) 122–123, fig. 99.

Valve, breadth, 0.006 mm; length, 0.09 to 0.1. Rare. Reported from Kizaki and Biwa Lakes.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. VENTER (Ehr.) Grun.

Fragilaria construens (Ehr.) Grun. var. *venter* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 141, fig. 138.

Valve lanceolate, attenuate at the ends. Length, 0.018 mm; breadth, 0.005. Striæ 14 in 0.01 mm. A fresh-water species.

SYNEDRA ULNA (Nitzsch) Ehr.

Synedra ulna (Nitzsch) Ehr., FR. HUSTEDT, Bacillar. (1930) 151–152, fig. 159*a*.

Valve linear with slightly subrostrate ends. Length, 0.3 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Reported from Kizaki and Biwa Lakes.

SYNEDRA ULNA (Nitzsch) Ehr. var. BICEPS (Kütz.).

Synedra ulna (Nitzsch) Ehr. var. *biceps* (Kütz.), FR. HUSTEDT, Bacillar. (1930) 154, fig. 166.

A variety with broad capitate ends. Length, 0.34 mm; breadth, 0.005. Common. Known from Kizaki Lake.

SYNEDRA AMPHICEPHALA Kütz. Plate 3, fig. 12.

Synedra amphicephala Kütz., FR. HUSTEDT, Bacillar. (1930) 156, fig. 173.

Valve linear, slightly attenuate towards the capitate ends. Length, 0.035 mm; breadth, 0.0025. Striæ 12 to 14 in 0.01 mm. Not common.

SYNEDRA RUMPENS Kütz. var. MENEGHINIANA Grun. Plate 1, fig. 6.

Synedra rumpens Kütz. var. *Meneghiniana* Grun., FR. HUSTEDT, Bacillar. (1930) 156, fig. 178.

Valve linear with subcapitate ends. Length, 0.062 mm; breadth, 0.004. Striæ robust, 15 in 0.01 mm. Reported from Kizaki and Biwa Lakes.

SYNEDRA RUMPENS Kütz. var. **OKAMURÆ** var. nov. Plate 4, figs. 10 and 11.

Valve linear with parallel margins, attenuate at the ends. Ends capitate. Length, 0.059 to 0.093 mm; breadth, 0.0034. Differs from the type in being larger and having broader striæ. Common in Ikeda Lake.

SYNEDRA PARASITICA (W. Smith).

Synedra parasitica (W. Smith), FR. HUSTEDT, Bacillar. (1930) 161, fig. 195.

Valve lanceolate with undulate middle part and pointed ends. Length, 0.022 mm; breadth, 0.0034. Striæ 16 in 0.01 mm. Not common. Reported from Kizaki and Biwa Lakes.

EUNOTIA FLEXUOSA Kütz. Plate 3, fig. 8.

Eunotia flexuosa Kütz., FR. HUSTEDT, Bacillar. (1930) 186, fig. 258.

Valve linear with parallel margins, flexous, with undulate and capitate ends. Length, 0.1 mm; breadth, 0.0028. Striæ 18 in 0.01 mm. Common.

EUNOTIA TENELLA (Grun.) Hust. Plate 4, fig. 6.

Eunotia tenella (Grun.) Hust., FR. HUSTEDT, Bacillar. (1930) 175, fig. 220.

Valve minute, linear, arcuate, and slightly attenuate. Length, 0.023 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Uncommon. Known from marshy waters.

COCCONEIS PLACENTULA (Ehr.) var. **EUGLYPTA** (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Valve ovate, crossed by ten broad, longitudinal, blank, undulating bands. Length, 0.025 mm; breadth, 0.015. A fresh-water species. Reported from Biwa Lake.

ACHNANTHES MINUTISSIMA Kütz. var. **CRYPTOCEPHALA** Grun.

Achnanthes minutissima Kütz. var. *cryptocephala* Grun., FR. HUSTEDT, Bacillar. (1930) 198, fig. 275.

Valve linear-elliptic, gradually attenuate towards the ends. Upper valve with a narrow, linear, axial area. Lower valve with a large, outwardly dilated, central area. Striæ very fine,

35 in 0.01 mm. Length, 0.017 mm; breadth, 0.0025. Common. Reported from Kizaki Lake.

ACHNANTHES PINNATA Hust. var. JAPONICA Hust.

Achnanthes pinnata Hust. var. *japonica* HUSTEDT, Bacillar. aus dem Aokikosee in Japan 161, pl. 5, figs. 12–15.

Valve minute, ovate with broad ends. Upper and lower valves with linear axial areas. Striæ radiate, 18 in 0.01 mm. Length, 0.006 mm; breadth, 0.0028. Common. Reported from Aokiko, Kizaki, and Biwa Lakes.

ACHNANTHES CLEVEI Grun.

Achnanthes Clevei Grun., FR. HUSTEDT, Bacillar. (1930) 203, fig. 294.

Valve lanceolate with attenuate ends. Length, 0.013 mm; breadth, 0.005. Not common. Reported from Biwa Lake.

ACHNANTHES LINEARIS W. Smith var. NIPPONICA var. nov. Plate 1, figs. 14 and 20.

Valve linear with broad rounded ends. Upper and lower valves with narrow, linear, axilar areas. Central area of the lower valve with somewhat dilated striæ. Length, 0.015 mm; breadth, 0.0034. Striæ 28 in 0.01 mm. Not common.

ACHNANTHES KIZAKI Skvortzow. Plate 2, fig. 9.

Achnanthes Kizaki SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 2, fig. 25.

Valve elongate, gibbous in the middle with broad capitate ends. Upper valve with narrow, linear, central and axilar areas. Lower valve with a rectangular central area. Length, 0.013 mm; breadth, 0.0025. Known from Kizaki Lake. Uncommon.

ACHNANTHES OKAMURÆ sp. nov. Plate 1, fig. 25.

Valve linear-elliptic, attenuate towards the ends. Upper and lower valves with narrow, linear, central and axial areas. Striæ slightly radiate. Length, 0.011 to 0.013 mm; breadth, 0.0028 to 0.003. Uncommon in Ikeda Lake. A distinct species akin to *A. linearis*.

RHOICOSPHENIA CURVATA (Kütz.) Grun.

Rhoicosphenia curvata (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 211, fig. 311.

Valve clavate, attenuate towards the ends. Length, 0.04 mm; breadth, 0.0068. Upper valve with narrow axial area and parallel striæ. Lower valve with elongate central area. Common. Reported from Kizaki and Biwa Lakes.

MASTOGLOIA ELLIPTICA Agardh var. DANSEI (Thwaites) Grun. Plate 1, fig. 11.

Mastogloia elliptica Agardh var. *dansei* (Thwaites) Grun., FR. HUSTEDT, Bacillar. (1930) 217, fig. 318.

Valve linear-elliptic with cuneate ends. Length, 0.037 mm; breadth, 0.01. Striæ 15 in 0.01 mm. Uncommon. Common in brackish or almost fresh water.

AMPHIPLEURA PELLUCIDA Kütz.

Amphipleura pellucida Kütz., FR. HUSTEDT, Bacillar. (1930) 218, fig. 321.

Valve linear-lanceolate with acute ends. Length, 0.085 mm; breadth, 0.006. Common. Known from fresh or slightly brackish water. Reported from Kizaki Lake.

AMPHIPLEURA PELLUCIDA Kütz. var. RECTA Kitton. Plate 2, fig. 3.

Amphipleura pellucida Kütz. var. *recta* KITTON, Journ. Quekett Microsc. Club (2) 2, 21, pl. 4, fig. 4.

Valve linear with gently cuneate ends. Length, 0.185 to 0.224 mm; breadth, 0.018 to 0.02. Striæ longitudinal, 25 to 30 in 0.01 mm. Puncta 25 to 30 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes. Found by Kitton in Nipponese oysters.

FRUSTULIA VULGARIS Thwaites.

Frustulia vulgaris Thwaites, FR. HUSTEDT, Bacillar. (1930) 221, fig. 327.

Valve narrow-lanceolate with subrostrate, obtuse ends. Length, 0.049 mm; breadth, 0.0085. Uncommon. Reported from Kizaki Lake.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. SAXONICA (Rabh.) de TONI fo. CAPITATA A. Mayer. Plate 2, fig. 14.

Frustulia rhomboides (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *capitata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 221.

Valve lanceolate with rostrate ends. Length, 0.054 mm; breadth, 0.014. Striæ 24 in 0.01 mm. Common. Reported from Kizaki Lake.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. AMPHIPLEUROIDES Grun. Plate 4, fig. 12.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun., FR. HUSTEDT, Bacillar. (1930) 221, fig. 326.

Valve lanceolate with attenuate ends. Central nodule large, elongate. Median line slightly eccentric. Length, 0.127 mm; breadth, 0.017. Uncommon. Reported from Kizaki and Biwa Lakes.

GYROSIGMA KÜTZINGII (Grun.) Cleve. Plate 1, fig. 4.

Gyrosigma Kützingii (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 224, fig. 333.

Valve sigmoid, lanceolate, with acute ends. Length, 0.153 mm; breadth, 0.018. Transverse striæ slightly radiate in the middle, 15 to 18 in 0.01 mm; longitudinal striæ 28 to 30 in 0.01 mm. Valves of Nipponese specimens are larger than those of the type from Europe. Common. Reported from Kizaki and Biwa Lakes.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. Plate 2, fig. 4.

Gyrosigma acuminatum (Kütz.) Rabh., FR HUSTEDT, Bacillar. (1930) 222, fig. 329.

Valve sigmoid, lanceolate, with acute ends. Transverse and longitudinal striæ equidistant, about 18 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

GYROSIGMA SPENCERII (W. Smith) Cleve var. OKAMURÆ var. nov. Plate 3, figs. 5 and 10.

Valve linear-lanceolate, sigmoid and obtuse. Length, 0.127 to 0.137 mm; breadth, 0.018 to 0.023. Transverse and longitudinal striæ equidistant, 12 to 15 in 0.01 mm. Differs from var. *Smithii* Grun. in having robust striæ. Common.

CALONEIS SILICULA (Ehr.) Cleve.

Caloneis silicula (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 236, fig. 362.

Valve gibbous in the middle, ends obtuse. Length, 0.034 mm; breadth, 0.008. Central area with a broad stauros. Striæ 25 in 0.01 mm. Not common.

CALONEIS SILICULA (Ehr.) Cleve var. TUMIDA Hust.

Caloneis silicula (Ehr.) Cleve var. *tumida* Hust., FR. HUSTEDT, Bacillar. (1930) 238, fig. 367.

Valve gibbous in the middle and attenuate at the ends. Length, 0.076 mm; breadth, 0.013. Striæ 18 in 0.01 mm. Uncommon. Reported from Biwa Lake.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPHIGOMPHUS (Ehr.) Van Heurck fo. ANGUSTA fo. nov. Plate 4, fig. 4.

Valve linear with cuneate ends. Length, 0.072 mm; breadth, 0.018. Striæ 18 in 0.01 mm. The European forms are larger and broader. Rare in Ikeda Lake.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPLIATA (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve var. *ampliata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 381.

Valve narrow, elliptic, with broad, subrostrate ends. Length, 0.059 mm; breadth, 0.013. Striæ 18 in 0.01 mm. Common.

NEIDIUM AFFINE (Ehr.) Cleve var. AMPHIRHYNCHUS (Ehr.) Cleve. Plate 2, fig. 1.

Neidium affine (Ehr.) Cleve var. *amphirhynchus* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 243, fig. 377.

Valve linear with protracted and rostrate ends. Length, 0.098 mm; breadth, 0.02. Striæ 21 in 0.01 mm. Common.

NEIDIUM OBLIQUESTRIATUM A. S. var. NIPPONICA Skvortzow.

Neidium obliquestriatum A. S. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 4, figs. 5, 22.

Valve lanceolate, gradually attenuate towards the ends or slightly subrostrate. Length, 0.085 mm; breadth, 0.022. Striæ oblique, 18 in 0.01 mm. Common. Known from Kizaki and Biwa Lakes.

NEIDIUM DUBIUM (Ehr.) Cleve.

Neidium dubium (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 384.

Valve elliptic with obtuse and subrostrate ends. Length, 0.042 mm; breadth, 0.013. Striæ fine, 25 in 0.01 mm. Reported from Kizaki Lake.

NEIDIUM DUBIUM (Ehr.) Cleve fo. CONSTRICTA Hustedt. Plate 2, fig. 16.

Neidium dubium (Ehr.) Cleve fo. *constricta* HUSTEDT, Bacillar. (1930) 246, fig. 384*b*.

Differs from the type in its constricted margin. Length, 0.037 mm; breadth, 0.015. Striæ 18 in 0.01 mm. Common. Reported from Biwa Lake.

DIPLONEIS OVALIS (Hilse) Cleve. Plate 1, fig. 3.

Diploneis ovalis (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve broad-elliptic. Central nodule large, rounded. Transverse rows of alveoli 10 to 12 in 0.01 mm. Length, 0.034 to 0.079 mm; breadth, 0.012 to 0.013. Striæ 10 to 12 in 0.01 mm. Uncommon. Reported from Kizaki, Aokiko, and Biwa Lakes.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naegeli) Cleve.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naegeli) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Valve linear-elliptic. Length, 0.017 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Uncommon. Reported from Biwa Lake.

DIPLONEIS ELLIPTICA (Kütz.) Cleve var. LADOGENSIS Cleve.

Diploneis elliptica (Kütz.) Cleve var. *ladogensis* Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 396.

Valve elliptic with broad, rounded ends. Transverse costæ 8 in 0.01 mm, irregularly anastomosing with a few, longitudinal, undulating costæ. Length, 0.051 mm; breadth, 0.034. Striæ 8 in 0.01 mm. Uncommon. Reported from Kizaki Lake.

DIPLONEIS SMITHII (Breb.) Cleve var. NIPPONICA Skvortzow.

Diploneis Smithii (Breb.) Cleve var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 2, figs. 1, 9.

Valve elliptic with a small, quadrate, central nodule. Furrows arcuate, closely following the central nodule. Costæ alternating with double rows of alveoli. Length, 0.073 mm; breadth, 0.034. Not common. Reported from Kizaki Lake.

DIPLONEIS PUELLA (Schumann) Cleve. Plate 1, fig. 29.

Diploneis puella (Schumann) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptic with broad, rounded ends. Central nodule small, quadrate. Furrows narrow. Costæ 18 in 0.01 mm. Alveoli indistinct. Differs from the type in having broad, rounded ends. Length, 0.015 mm; breadth, 0.0068. Striæ 18 in 0.01 mm. Common in Ikeda Lake. Reported from Kizaki and Biwa Lakes.

DIPLONEIS OCULATA (Breb.) Cleve.

Diploneis oculata (Breb.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 392.

Valve elongate-elliptic. Length, 0.017 mm; breadth, 0.0068. Central nodule small. Costæ 15 to 18 in 0.01 mm. Common. Reported from Kizaki and Aokiko Lakes.

STAURONEIS PHŒNICENTERON Ehr. fo. GRACILIS Dip.

Stauroneis phœnicenteron Ehr. fo. *gracilis* Dip., FR. HUSTEDT, Bacillar. (1930) 255.

Valve lanceolate with long-attenuate ends. Length, 0.081 mm; breadth, 0.015. Striæ 18 in 0.01 mm. Common.

STAURONEIS SIGNATA (Meister) nob.

Stauroneis phœnicenteron Ehr. var. *signata* MEISTER, Kieselalgen aus Asien (1932) 45, figs. 149, 150.

Valve lanceolate with a broad middle part. Length, 0.093 to 0.15 mm; breadth, 0.015 to 0.035. Striæ 18 in 0.01 mm. Stau-

ros broad with marginal, alternately longer and shorter striæ. Rare. Reported by Fr. Meister in Ta-Hu and Kuang-Fong in China, and by me in Great Hingan, northern Manchuria, and at Seiriori in Chosen, Nippon.

STAURONEIS SIGNATA (Meister) nob. fo. **GRACILIS** fo. nov.

A form with a smaller and narrower valve. Length, 0.093 mm; breadth, 0.015. Striæ 18 in 0.01 mm. Not common.

STAURONEIS ANCEPS Ehr.

Stauroneis anceps Ehr., FR. HUSTEDT, Bacillar. (1930) 256, fig. 405.

Valve lanceolate with rostrate ends. Length, 0.051 mm; breadth, 0.012. Common. Reported from Kizaki Lake.

STAURONEIS ANCEPS Ehr. fo. **GRACILIS** (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Valve lanceolate, with very fine striæ. Length, 0.052 mm; breadth, 0.015. Not common. Reported from Kizaki Lake.

ANOMŒONEIS EXILIS (Kütz.) Cleve var. **LANCEOLATA** A. Mayer. Plate 2, fig. 2.

Anomœoneis exilis (Kütz.) Cleve var. *lanceolata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 264.

Valve lanceolate with protracted ends. Length, 0.027 mm; breadth, 0.005. Striæ very fine, about 30 in 0.01 mm. Uncommon. Reported from alpine regions.

NAVICULA CUSPIDATA Kütz. Plate 4, fig. 9.

Navicula cuspidata Kütz., FR. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Valve rhombic-lanceolate, with acute ends. Length, 0.085 mm; breadth, 0.03. Common. Reported from Kizaki Lake.

NAVICULA HALOPHILA (Grun.) Cleve var. **OKAMURÆ** var. nov. Plate 4, fig. 5.

Valve linear-lanceolate, with parallel margins in the middle and subrostrate, obtuse ends. Length, 0.068 mm; breadth, 0.017. Striæ 13 to 14 in 0.01 mm. Differs from the type in having obtuse ends and broader striæ. The type is known from brackish water.

NAVICULA VENTRALIS Krasske var. **OKAMURÆ** var. nov. Plate 1, figs. 17 and 18.

Valve gibbous in the middle, with broad capitate ends. Length, 0.013 to 0.018 mm; breadth, 0.005. Striæ 25 to 30 in 0.01 mm. Median line straight, axial area moderately broad, dilated in the middle. Central area a broad stauros, widened

and truncate outward. Differs from the type in its shorter ends. Common.

NAVICULA MUTICA Kütz.

Navicula mutica Kütz., FR. HUSTEDT, Bacillar. (1930) 274, fig. 453*a*.

Valve lanceolate, with obtuse ends. Length, 0.015 mm; breadth, 0.006. Not common. Reported from Kizaki Lake.

NAVICULA PUPULA Kütz. var. CAPITATA Hust.

Navicula pupula Kütz. var. *capitata* FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*c*.

Valve linear-lanceolate, with broad capitate ends. Length, 0.037 mm; breadth, 0.0085. Striæ 18 to 20 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

NAVICULA PUPULA Kütz. var. ELLIPTICA Hust. Plate 1, fig. 2.

Navicula pupula Kütz. var. *elliptica* FR. HUSTEDT, Bacillar. (1930) 282, fig. 467*d*.

Valve minute, lanceolate and obtuse. Length, 0.013 mm; breadth, 0.005. Striæ 24 to 25 in 0.01 mm. Not common.

NAVICULA PUPULA Kütz. var. RECTANGULARIS (Greg.) Grun.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grun., FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*b*.

Valve linear, with parallel margins and broad, obtuse ends. Length, 0.039 mm; breadth, 0.01. Striæ 18 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

NAVICULA SUBTILISSIMA Cleve var. OKAMURÆ var. nov. Plate 1, fig. 12.

Valve slightly siliceous, linear-lanceolate, attenuate at the broad, subcapitate ends. Length, 0.017 mm; breadth, 0.003. Differs from the type in its broad, subcapitate ends. Not common.

NAVICULA RHYNCHOCEPHALA Kütz.

Navicula rhynchocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 296, fig. 501.

Valve lanceolate, with attenuate ends. Length, 0.042 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

NAVICULA ROSTELLATA Kütz.

Navicula rostellata Kütz., FR. HUSTEDT, Bacillar. (1930) 297, fig. 502.

Valve linear-lanceolate, gradually attenuate towards the ends. Length, 0.037 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Not common. Reported from Kizaki Lake.

NAVICULA HUNGARICA Grun. var. **CAPITATA** (Ehr.) Cleve. Plate 1, fig. 21.

Navicula hungarica Grun. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 298, fig. 508.

Valve elliptic-lanceolate, undulate with rostrate ends. Length, 0.017 mm; breadth, 0.005. Striæ 9 in 0.01 mm. Common.

NAVICULA RADIOSA Kütz.

Navicula radiosa Kütz., FR. HUSTEDT, Bacillar. (1930) 299, fig. 513.

Valve narrow, lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.091 mm; breadth, 0.01. Striæ 9 to 10 in 0.01 mm. Not common. Reported from Kizaki Lake.

NAVICULA RADIOSA Kütz. fo. **NIPPONICA** Skv.

Navicula radiosa Kütz. fo. *nipponica* SKVORTZOW, Diatoms Biwa Lake (1936) pl. 2, fig. 2; pl. 13, fig. 20.

Differs from the type in having a narrower valve. Length, 0.042 mm; breadth, 0.006. Striæ not striolate, 12 in 0.01 mm. Not common. Known from Biwa Lake.

NAVICULA FALAISIENSIS Grun. var. **LANCEOLA** Grun. Plate 1, fig. 22.

Navicula falaisiensis Grun. var. *lanceola* Grun., FR. HUSTEDT, Bacillar. (1930) 302, fig. 524.

Valve narrow, linear-lanceolate with rostrate ends. Central area narrow, striæ slightly radiate. Length, 0.023 mm; breadth, 0.005. Striæ 18 in 0.01 mm. Reported from Kizaki Lake.

NAVICULA ANGLICA Ralfs. Plate 2, fig. 12.

Navicula anglica Ralfs, FR. HUSTEDT, Bacillar. (1930) 303, figs. 530-531.

Valve elliptic with subrostrate ends. Length, 0.022 mm; breadth, 0.009. Striæ 13 in 0.01 mm. Rare. Known from Kizaki Lake.

NAVICULA GASTRUM Ehr.

Navicula gastrum Ehr., FR. HUSTEDT, Bacillar. (1930) 305, fig. 537.

Valve elliptic with subrostrate ends. Striæ radiate in the middle, alternately longer and shorter. Length, 0.037 mm; breadth, 0.015. A fresh-water species.

NAVICULA LANCEOLATA (Agardh) Kütz. Plate 2, fig. 15.

Navicula lanceolata (Agardh) Kütz., FR. HUSTEDT, Bacillar. (1930) 305, fig. 540.

Valve lanceolate with attenuate ends. Length, 0.027 to 0.042 mm; breadth, 0.0068 to 0.0085. Striæ lineolate, radiate, 15 in 0.01 mm. Common. Reported from Kizaki Lake.

NAVICULA HASTA Pant. fo. **MINOR** fo. nov. Plate 1, fig. 16.

Differs from the type in having minute valves. Length, 0.042 mm; breadth, 0.009. Striæ lineolate, 12 in 0.01 mm. Not common.

NAVICULA EXIGUA (Greg.) O. Müll.

Navicula exigua (Greg.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 305, fig. 58.

Valve lanceolate with rostrate-capitate ends. Length, 0.023 mm; breadth, 0.0085. Striæ radiate, 12 in 0.01 mm. Three median striæ much shorter than the others. Not common. Reported from Kizaki and Biwa Lakes.

NAVICULA GLOBULIFERA Hust. var. **NIPPONICA** Skvortzow.

Navicula globulifera Hust. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 3, fig. 10.

Valve lanceolate, attenuate. Length, 0.059 mm; breadth, 0.0068 to 0.007. Striæ radiate, 11 to 12 in 0.01 mm. Not common. Reported from Kizaki Lake.

NAVICULA TUSCULA (Ehr.) Grun. Plate 1, fig. 13.

Navicula tuscula (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 308, fig. 552.

Valve elliptic with protracted ends. Length, 0.062 mm; breadth, 0.15. Striæ crossed by several, irregularly undulating, longitudinal bands, 11 in 0.01 mm. Common in Ikeda Lake. Known from fresh and slightly brackish water.

NAVICULA IKARI Skvortzow var. **NIPPONICA** var. nov. Plate 1, fig. 10.

Valve linear-elliptic, slightly attenuate towards the broad, obtuse ends. Length, 0.018 mm; breadth, 0.0038. Axial area narrow, central area a broad, triangular stauros. Striæ very fine, about 35 in 0.01 mm. Differs from the type in being smaller and having finer striæ. The type is known from Biwa Lake.

NAVICULA MINIMA Grun. var. **OKAMURÆ** var. nov. Plate 1, fig. 23.

Valve linear-elliptic, broad and obtuse. Length, 0.012 mm; breadth, 0.005. Striæ radiate, about 24 to 28 in 0.01 mm. Differs from the type in the undulate valve. Rare. *Navicula minima* Grun. is reported from Europe.

NAVICULA ATOMARIUS Skvortzow. Plate 1, fig. 19.

Navicula atomarius SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 2, fig. 13.

Valve linear, convex and obtuse. Length, 0.009 mm; breadth, 0.0036. Striæ very fine, about 40 in 0.01 mm. Central area

broad, axial area narrow and linear. Not common. Reported from Kizaki Lake.

PINNULARIA MICROSTAURON (Ehr.) Cleve. Plate 3, fig. 11.

Pinnularia microstauron (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 320, fig. 582.

Valve linear-lanceolate with nearly parallel margins and rostrate ends. Length, 0.039 mm; breadth, 0.01. Striæ 12 in 0.01 mm. Not common. Reported from Kizaki Lake.

PINNULARIA KARELICA Cleve var. JAPONICA Hust.

Pinnularia karelica Cleve var. *japonica* HUSTEDT, Bacillar. aus dem Aokikosee in Japan 165, pl. 5, fig. 3.

Valve linear with broad and obtuse ends. Length, 0.054 mm; breadth, 0.013. Common. Reported from Aokiko, Kizaki, and Biwa Lakes.

PINNULARIA LEGUMEN Ehr.

Pinnularia legumen Ehr., FR. HUSTEDT, Bacillar. (1930) 322, fig. 587.

Valve linear-lanceolate, triundulate with capitate ends. Length, 0.096 to 0.0119 mm; breadth, 0.012 to 0.017. Striæ 9 in 0.01 mm. Common. Reported from Kizaki Lake.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. KIZAKENSIS Skvortzow.

Pinnularia microstauron (Ehr.) Cleve var. *kizakensis* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 6, fig. 7.

Pinnularia divergens W. Smith var. *japonica* MEISTER, Beiträge zur Bacillar. Japans 2 (1914) 229, pl. 8, fig. 9 (not 8).

Valve linear-lanceolate with attenuate and truncate ends. Length, 0.047 mm; breadth, 0.01. Striæ 12 to 15 in 0.01 mm. Axial area in the middle dilated to an elliptic space only on one side to the transverse fascia. Not common. Known from the Botanical Garden of Tokyo and from Kizaki Lake.

PINNULARIA PLATYCEPHALA (Ehr.) Cleve.

Pinnularia platycephala (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 324, fig. 593.

Valve linear, slightly triundulate with subcapitate ends. Length, 0.086 mm; breadth, 0.017. Striæ 9 in 0.01 mm. Not common. Known from Kizaki Lake.

PINNULARIA BOREALIS Ehr. Plate 2, figs. 5 and 17.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Valve linear or linear-elliptic with broad ends. Length, 0.042 to 0.051 mm; breadth, 0.006 to 0.01. Striæ robust, slightly ra-

diate, 6 in 0.01 mm. Common. Known from Kizaki and Biwa Lakes.

PINNULARIA GIBBA Ehr.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600.

Valve linear, gibbous in the middle and with capitate ends. Length, 0.059 to 0.083 mm; breadth, 0.0085 to 0.012. Striæ 9 to 10 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

PINNULARIA GIBBA Ehr. fo. SUBUNDULATA Mayer.

Pinnularia gibba Ehr. fo. *subundulata* Mayer, FR. HUSTEDT, Bacillar. (1930) 327, fig. 601.

Differs from the type in its slightly undulate margins. Length, 0.06 mm; breadth, 0.0085 to 0.009. Striæ 11 to 12 in 0.01 mm. Common. Known from Kizaki Lake.

PINNULARIA GIBBA Ehr. var. NIPPONICA Skvortzow.

Pinnularia gibba Ehr. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 7, fig. 10.

Valve slightly triundulate with capitate ends. Length, 0.098 mm; breadth, 0.017. Striæ 9 to 10 in 0.01 mm. Differs from Kizaki specimens in its broader valves. Not common in Ikeda Lake.

PINNULARIA GIBBA Ehr. var. OKAMURÆ var. nov. Plate 2, fig. 7.

Valve almost linear with broad, rounded ends. Axial area linear in the middle, forming a broad transverse fascia. Length, 0.057 mm; breadth, 0.012. Striæ 10 to 11 in 0.01 mm. Differs from the type in its parallel margins and its small size. Common.

PINNULARIA LIGNITICA Cleve. Plate 4, fig. 8.

Pinnularia lignitica Cleve, A. SCHMIDT, Atlas Diatom. (1914) pl. 313, fig. 7.

Valve rhombic-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.076 mm; breadth, 0.018. Striæ radiate, 12 in 0.01 mm, with two, distinct, longitudinal lines. Common. Known as a fossil in Nipponese lignite and living in Kizaki Lake.

PINNULARIA HUSTEDTI Meister var. NIPPONICA var. nov. Plate 2, fig. 6.

Valve linear, slightly undulate in the middle, attenuate to the capitate ends. Length, 0.205 mm; breadth, 0.025. Striæ 6 in 0.01 mm. Longitudinal bands distinct. Common. It differs

from the type in its more robust striæ and broader valves. The type is known from Canton River, China.

PINNULARIA MAJOR (Kütz.) Cleve.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 331, fig. 614.

Valve linear, gibbous in the middle and at the rounded ends. Length, 0.147 mm, breadth, 0.022. Median line not complex. Striæ 7 in 0.01 mm, crossed by a narrow band. Common. Reported from Kizaki Lake.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. FALLAX Cleve.

Pinnularia viridis (Nitzsch) Ehr. var. *fallax* Cleve, A. SCHMIDT, Atlas Diatoms (1876) pl. 43, fig. 24; pl. 45, figs. 10, 11.

Valve elliptic-linear. Length, 0.085 mm; breadth, 0.013. Striæ almost parallel, 9 in 0.01 mm, unilaterally interrupted. Common. Reported from Kizaki and Biwa Lakes.

PINNULARIA GENTILIS (Donk.) Cleve.

Pinnularia gentilis (Donk.) Cleve, FR. HUSTEDT, Bacillar. (1930) 335, fig. 618.

Valve linear with parallel margins and broad, rounded ends. Length, 0.22 mm; breadth, 0.032. Striæ 6 in 0.01 mm. Median line complex. Not common.

PINNULARIA KIUSIUENSIS sp. nov. Plate 3, fig. 4.

Valve linear-lanceolate with broad, subcapitate ends. Length, 0.078 mm; breadth, 0.013. Median line filiform. Axial area distinct, in the middle dilated to an elliptic space, on one side to a transverse fascia. Striæ 9 in 0.01 mm, divergent in the middle, convergent at the ends, with a distinct, longitudinal band. Differs from *P. rangoonensis* Grun.[1] in its distinct band. Common.

AMPHORA OVALIS Kütz.

Amphora ovalis Kütz., FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Frustule robust and ovate. Length, 0.083 mm; breadth, 0.037. Striæ 9 to 10 in 0.01 mm. Common. Reported from Biwa Lake.

AMPHORA OVALIS Kütz. forma GRACILIS Kütz.

Amphora ovalis Kütz., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Differs from the type in its narrower valve. Length, 0.027 mm; breadth, 0.005. Striæ 14 to 15 in 0.01 mm. Common. Known from Kizaki Lake.

[1] Ehrenberg, Microgeologie (1854) 33, pl. 2, fig. 7.

AMPHORA OVALIS Kütz. var. LIBYCA (Ehr.) Cleve.

Amphora libyca Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Valve lunate. Length, 0.045 mm; breadth, 0.022. Central area distinct on the dorsal side, with an irregular blank band across the striæ. Uncommon in Ikeda Lake. Reported from Kizaki and Biwa Lakes.

AMPHORA OVALIS Kütz. var. PEDICULUS Kütz.

Amphora ovalis Kütz. var. *pediculus* Kütz., FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Valve lunate. Length, 0.012 mm; breadth, 0.0034. Central area distinct. Uncommon. Known from fresh and slightly brackish water. Reported from Kizaki and Biwa Lakes.

AMPHORA NORMANI Rabh. Plate 1, fig. 32.

Amphora Normani Rabh., FR. HUSTEDT, Bacillar. (1930) 343, fig. 630.

Valve lunate with undulate dorsal and ventral sides and capitate ends. Length, 0.017 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Known from alpine regions. Reported from Kizaki Lake.

CYMBELLA MICROCEPHALA Grun.

Cymbella microcephala Grun., FR. HUSTEDT, Bacillar. (1930) 351, fig. 637.

Valve slightly asymmetric, lanceolate, with subcapitate ends. Length, 0.017 mm; breadth, 0.0034. Striæ very fine, 30 in 0.01 mm. Not common. Known from Kizaki Lake.

CYMBELLA LEPTOCEROS (Ehr.) Grun. Plate 1, fig. 9.

Cymbella leptoceros (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 353, fig. 645.

Valve asymmetric, lanceolate, with slightly gibbous ventral margin. Ends attenuate and obtuse. Length, 0.034 mm; breadth, 0.01. Striæ 12 in 0.01 mm. Not common.

CYMBELLA ALPINA Grun. fo. NIPPONICA fo. nov. Plate 1, fig. 5.

Valve slightly asymmetric, lanceolate, with obtuse ends. Length, 0.04 mm; breadth, 0.0085. Striæ lineolate, 12 in 0.01 mm. Differs from the type in the number of striæ. Not common.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella sp., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 51, 52.

Valve slightly asymmetric, with rostrate and truncate ends. Length, 0.074 mm; breadth, 0.022. Striæ 9 in 0.01 mm. An Arctic species. Reported from Kizaki and Biwa Lakes.

CYMBELLA PROSTRATA (Berkeley) Cleve.

Eucyonema prostratum Ralfs, A. SCHMIDT, Atlas Diatom. (1875) pl. 10, figs. 64–69.

Valve strongly asymmetric, with obtuse ends. Length, 0.037 mm; breadth, 0.01. Striæ striolate, dorsal and ventral 9 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

CYMBELLA TURGIDA (Greg.) Cleve fo. **MINOR** fo. nov. Plate 1, fig. 30.

Valve slightly asymmetric, lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.02 mm; breadth, 0.006. Striæ 12 in 0.01 mm. The type is common in the Tropics. Our specimens are smaller than the type. Common.

CYMBELLA VENTRICOSA Kütz.

Cymbella ventricosa Kütz., FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Valve lunate, with gibbous ventral margin. Length, 0.017 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

CYMBELLA GRACILIS (Rabh.) Cleve.

Cymbella gracilis (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) 359, fig. 663.

Valve elongate, narrow, with gently arcuate dorsal, and slightly arcuate ventral, margins. Length, 0.027 mm; breadth, 0.004. Striæ 12 in 0.01 mm. Common. Reported from Kizaki Lake.

CYMBELLA HYBRIDA Grun.

Cymbella hybrida Grunow, CLEVE, Synopsis Navicul. Diatom. (1894) 1, 166, pl. 4, fig. 23.

Valve linear, almost symmetric, with parallel margins and rostrate ends. Length, 0.064 mm; breadth, 0.012. Striæ finely punctate, 12 in 0.01 mm. Common. Reported from Kizaki Lake, Nippon, and from Hanka Lake, Siberia.

CYMBELLA TURGIDULA Grun. Plate 1, fig. 24.

Cymbella turgidula Grun., A. SCHMIDT, Atlas Diatom. (1931) pl. 376, fig. 8.

Valve asymmetric, lanceolate, tapering from the middle to the obtuse ends. On the ventral side of the central nodule are two small puncta, ending the median striæ. Common in Ikeda Lake. Reported from Kizaki Lake.

CYMBELLA CYMBIFORMIS (Agardh ? Kütz.) Van Heurck.

Cymbella cymbiformis (Agardh? Kütz.) VAN HEURCK.

Valve boat-shaped, with slightly gibbous ventral margin and obtuse ends. Length, 0.068 to 0.091 mm; breadth, 0.015 to 0.017.

Striæ 6 to 9 in 0.01 mm. On the ventral side of the central nodule is an isolated punctum at the end of the median striæ. Very common. Reported from Kizaki Lake.

CYMBELLA CISTULA (Hemp.) Grun.

Cymbella cistula (Hemp.) Grun., FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*a*.

Valve boat-shaped. On the ventral side, near the central nodule, the striæ are interrupted by a narrow depression with five isolated puncta. Length, 0.042 mm; breadth, 0.01. Striæ 9 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

CYMBELLA ASPERA (Ehr.) Cleve. Plate 4, fig. 1.

Cymbella aspera (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 365, fig. 680.

Valve boat-shaped, with arcuate dorsal margin. Length, 0.17 mm; breadth, 0.034. Dorsal striæ 5, ventral 8, in 0.01 mm. Puncta 12 in 0.01 mm. Common. Reported from Kizaki Lake.

CYMBELLA AUSTRALICA A. S.

Cymbella australica A. S., A. SCHMIDT, Atlas Diatom. (1875) pl. 10, figs. 34, 35.

Valve boat-shaped. Length, 0.091 mm; breadth, 0.022. Striæ radiate in the middle, with a large stigma below the central nodule, 7 to 8 in 0.01 mm. Not common. Known from Australia, New Zealand, Nippon, and Hanka Lake, Siberia.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 370, fig. 684.

Valve biconstricted, with apiculate apex. Length, 0.055 mm; breadth, 0.008. Common. Reported from Kizaki and Biwa Lakes.

GOMPHONEMA AUGUR Ehr. var. GAUTIERI Van Heurck. Plate 1, fig. 27.

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, FR. HUSTEDT, Bacillar. (1930) 372, fig. 689.

Valve biconstricted, with broad apex. Length, 0.061 mm; breadth, 0.013. Striæ 10 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

GOMPHONEMA AUGUR Ehr. var. OKAMURÆ var. nov. Plate 4, fig. 13.

Valve clavate, with truncate-apiculate apex and narrow base. Length, 0.057 mm; breadth, 0.015. Central area short, unilateral, with two stigmata. Striæ 9 in 0.01 mm. Not common.

Differs from variety *Gautieri* by the presence of two isolated stigmata.

GOMPHONEMA INTRICATUM Kütz. Plate 3, fig. 7.

Gomphonema intricatum Kütz., FR. HUSTEDT, Bacillar. (1930) 375, fig. 697.

Valve narrow-clavate, gradually tapering from the middle to the subacute ends. Apex broad. Length, 0.049 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA (Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1936) 377, fig. 715.

Valve clavate, constricted, with broad capitate apex. Length, 0.037 mm; breadth, 0.012. Common. Reported from Kizaki and Biwa Lakes.

GOMPHONEMA VASTUM Hust. var. MAXIMA Skvortzow. Plate 1, fig. 8.

Gomphonema vastum Hust. var. *maxima* SKVORTZOW, Diatoms Biwa Lake (1936) pl. 8, fig. 7.

Valve narrow, lanceolate, gradually attenuate towards the subacute ends. Length, 0.047 mm; breadth, 0.006. Striæ 15 in 0.01 mm, marginate, radiate at the ends, with a distinct isolated punctum. Common. The specimens from Ikeda Lake are smaller than the type from Biwa.

GOMPHONEMA GLOBIFERUM Meister. Plate 1, fig. 1.

Gomphonema globiferum MEISTER, Beiträge zur Bacillar. Japans (1914) 212, pl. 4, fig. 13.

Valve subtruncate, narrow-lanceolate, gradually tapering from the middle to the ends. Apex broad-capitate, base subacute. Striæ slightly radiate, 12 in 0.01 mm. Median punctum distinct. Not common. Known from Suwa Lake, Nippon.

GOMPHONEMA IKEDA sp. nov. Plate 4, fig. 7.

Valve slightly clavate, linear-lanceolate, gradually attenuate towards the subacute ends. Apex with a distinct band. Length, 0.062 mm; breadth, 0.0068. Striæ slightly radiate, 6 in the middle, 12 in 0.01 mm at the ends. Central area unilateral and the isolated punctum distinct. Common. Differs from *G. bohemicum* in its greater length and in the presence of the band in the upper part of the valve.

GOMPHONEMA PUIGGARIANUM Grun. Plate 3, fig. 13.

Gomphonema Puiggarianum Grun., VAN HEURCK, Synopsis (1884–1885) pl. 25, fig. 18.

Valve clavate, attenuate towards the ends. Upper part broad, lower part narrow. Length, 0.042 mm; breadth, 0.006. Striæ marginate, parallel, 10 to 11 in 0.01 mm. Axial and central areas broad without isolated punctum. Differs from the type in its size and the number of striæ, from *G. Licenti* Skv. in its marginal striæ.

EPITHEMIA ARGUS Kütz. var. ALPESTRIS W. Sm. Plate 1, fig. 7.

Epithemia argus Kütz. var. *alpestris* W. Sm., A. SCHMIDT, Atlas Diatom. (1904) pl. 251, figs. 2, 3, 9.

Valve lunate and obtuse. Length, 0.024 mm; breadth, 0.007. Striæ 12 in 0.01 mm. Known from fresh water.

EPITHEMIA ZEBRA (Ehr.) Kütz.

Epithemia zebra (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 384–385, fig. 729*a*, *b*.

Valve lunate, attenuate towards the obtuse ends. Length, 0.076 mm; breadth, 0.013. Very common. Known from Kizaki Lake.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. PORCELLUS (Kütz.) Grun.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 385, fig. 731.

Differs from the type in its subcapitate ends. Length, 0.064 mm; breadth, 0.008. Not common. Known from Biwa Lake.

EPITHEMIA SOREX Kütz.

Epithemia sorex Kütz., FR. HUSTEDT, Bacillar. (1930) 388, fig. 736.

Valve boat-shaped, with arcuate dorsal side and rostrate-truncate ends. Length, 0.03 mm; breadth, 0.007. Common. Known from Kizaki and Biwa Lakes.

RHOPALODIA PARALLELA (Grun.) O. Müll. Plate 3, fig. 2.

Rhopalodia parallela (Grun.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 389, fig. 739.

Valve linear, slightly narrow-lanceolate with almost parallel margins. Length, 0.085 to 0.105 mm; breadth, 0.017 to 0.025. Striæ 5 in 0.01 mm. Common. An alpine species, reported from Kizaki and Biwa Lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Valve linear, arcuate on the dorsal side, straight on the ventral side, reflexed at the extremities. Length, 0.085 to 0.29 mm. Common. Reported from Kizaki and Biwa Lakes.

RHOPALODIA GIBBERULA (Ehr.) O. Müll. var. VAN HEURCKI O. Müll. Plate 1, fig. 26.

Rhopalodia gibberula (Ehr.) O. Müll. var. *Van Heurcki* O. Müll., A. SCHMIDT, Atlas Diatom. (1904) pl. 255, fig. 21; pl. 265, fig. 14.

Valve lunate, arcuate on the dorsal side, parallel on the ventral side. Length, 0.034 mm; breadth, 0.007. Striæ 18 in 0.01 mm. Common. A brackish-water diatom.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun.

Hantzschia amphioxys (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Valve linear-lanceolate, with abruptly attenuate and subrostrate ends. Length, 0.054 mm; breadth, 0.0068. Common. Reported from Kizaki and Biwa Lakes.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. VIVAX (Hantzsch) Grun. Plate 3, fig. 3.

Hantzschia amphioxys (Ehr.) Grun. var. *vivax* (Hantzsch) Grun., FR. HUSTEDT, Bacillar. (1930) 394, fig. 750.

Differs from the type in its longer lanceolate valve, tapering from the middle to the subacute ends. Length, 0.102 mm; breadth, 0.0085. Costæ 7, striæ 18, in 0.01 mm. Not common.

NITZSCHIA TRYBLIONELLA Hantz. var. DEBILIS (Arnott) A. Mayer.

Nitzschia tryblionella Hantz. var. *debilis* (Arnott) A. Mayer, FR. HUSTEDT, Bacillar. (1930) 400, fig. 759.

Valve broad-elliptic with cuneate ends. Length, 0.02 mm; breadth, 0.0085. Costæ 15 in 0.01 mm. Common. Reported from Biwa Lake. Known from brackish water.

NITZSCHIA TRYBLIONELLA Hantz. var. VICTORIÆ Grun. Plate 2, fig. 11.

Nitzschia tryblionella Hantz. var. *Victoriæ* Grun., FR. HUSTEDT, Bacillar. (1930) 399, fig. 758.

Valve broad-elliptic, constricted in the middle part. Length, 0.059 mm; breadth, 0.028. Costæ 5 to 6 in 0.01 mm. Common. A brackish-water diatom. Known from Biwa Lake.

NITZSCHIA DISSIPATA (Kütz.) Grun.

Nitzschia dissipata (Kütz.) Grun., A. SCHMIDT, Atlas Diatom. (1921) pl. 332, fig. 23.

Valve narrow-lanceolate, with long capitate ends. Length, 0.045 mm; breadth, 0.005. Costæ 6 to 7 in 0.01 mm. Striæ indistinct. Common. Reported from Kizaki Lake.

NITZSCHIA AMPHIBIA Grun. Plate 1, fig. 31.

Nitzschia amphibia Grun., FR. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve lanceolate, with subacute ends. Length, 0.013 mm; breadth, 0.0034. Common.

NITZSCHIA DENTICULA Grun. Plate 1, fig. 15.

Nitzschia denticula Grun., FR. HUSTEDT, Bacillar. (1930) 407, fig. 780.

Valve lanceolate, with subacute ends. Length, 0.028 mm; breadth, 0.006. Costæ very distinct, 5 in 0.01 mm. Striæ punctate, 15 in 0.01 mm. Common.

NITZSCHIA HEIDENI Meister.

Nitzschia Heideni Meister, A. SCHMIDT, Atlas Diatom. (1924) pl. 351, fig. 11.

Valve broad-lanceolate, with long, subacute ends. Length, 0.013 mm; breadth, 0.0025. Costæ very distinct, long, length about one-half the valve breadth. Common. Known from Tokyo, Nippon.

NITZSCHIA OBTUSA W. Smith var. **SCALPELLIFORMIS** Grun. Plate 4, fig. 2.

Nitzschia obtusa W. Smith var. *scalpelliformis* Grun., FR. HUSTEDT, Bacillar. (1930) 422, fig. 817*d*.

Valve linear-lanceolate and slightly sigmoid. Length, 0.035 mm; breadth, 0.0034. Costæ 6 in 0.01 mm. Not common. A brackish-water diatom.

NITZSCHIA ACUTA Hantzsch.

Nitzschia acuta Hantzsch., FR. HUSTEDT, Bacillar. (1930) 412, fig. 790.

Valve narrow, linear-lanceolate, gradually attenuate towards the subcapitate ends. Length, 0.136 mm; breadth, 0.005. Costæ 6 in 0.01 mm. Common. Known from Kizaki and Biwa Lakes.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. **PERPUSILLA** (Rabh.) Grun. Plate 1, fig. 28.

Nitzschia frustulum (Kütz.) Grun. var. *perpusilla* (Rabh.) Grun., VAN HEURCK, Synopsis (1884–1885) pl. 99, fig. 6.

Valve lanceolate with cuneate ends. Length, 0.017 mm; breadth, 0.0034. Costæ 12, striæ 24, in 0.01 mm. Not common. Known from brackish water.

NITZSCHIA OKAMURÆ sp. nov. Plate 3, fig. 9.

Valve sublinear or narrow-lanceolate, gradually attenuate towards the subacute end. Length, 0.061 mm; breadth, 0.005. Costæ 6 to 7 in 0.01 mm. Striæ indistinct. This new species is intimately connected with *N. gandersheimiensis* Krasske.

CYMATOPLEURA SOLEA (Breb.) W. Smith.

Cymatopleura solea (Breb.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 425, fig. 823*a*.

Valve linear, constricted in the middle part. Ends cuneate. Not common. Known from Biwa Lake.

SURIRELLA ROBUSTA Ehr.

Surirella robusta Ehr., FR. HUSTEDT, Bacillar. (1930) 437, fig. 850.

Valve elongate-ovate, one end much broader than the other. Length, 0.195 mm; breadth, 0.085. Costæ robust, radiate at the ends. Pseudoraphe lanceolate. Common. Reported from Kizaki Lake.

SURIRELLA ROBUSTA Ehr. fo. LATA Hust.

Surirella robusta Ehr. fo. *lata* FR. HUSTEDT, Bacillar. aus dem Aokikosee in Japan 169–170, fig. 1.

This form differs from the type in its broader valves. Length, 0.185 mm; breadth, 0.085. Common. Reported from Kizaki and Aokiko Lakes.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 437, figs. 851–852.

Like the type, but with coarser costæ. Length, 0.144 mm; breadth, 0.051. Common. Reported from Kizaki and Biwa Lakes.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck fo. NIPPONICA fo. nov. Plate 4, fig. 3.

Valve elongate-ovate, rounded at one end and acute at the other. Length, 0.144 mm; breadth, 0.037. Costæ 2 in 0.01 mm, with intercostal striæ 18 in 0.01 mm. Pseudoraphe lanceolate, narrow, with distinct little spines. Not common.

SURIRELLA ROBUSTA Ehr. var. OKAMURÆ var. nov. Plate 3, fig. 6.

Valve rhomboidal-elliptic, with acute ends. One end much broader than the other. Length, 0.09 mm; breadth, 0.034. Costæ 1.5 in 0.01 mm. Marginal alæ robust, outer rim distinct. Not common. This is a distinct variety akin to forma *Hustedtiana* (Mayer) Hust.

SURIRELLA LINEARIS W. Smith.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 434, figs. 837, 838.

Valve linear-lanceolate, with margins parallel in the middle, gradually attenuate towards the cuneate ends. Length, 0.068

mm; breadth, 0.012. Costæ reaching the pseudoraphe. Common. Known from Kizaki Lake.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister, FR. HUSTEDT, Bacillar. (1930) 434, fig. 840.

Valve linear, cuneate. Length, 0.115 to 0.127 mm; breadth, 0.028 to 0.03. Costæ 20 in 0.01 mm. Pseudoraphe distinct and punctate. Common. Known from Kizaki Lake.

SURIRELLA BISERIATA Breb.

Surirella biseriata Breb., FR. HUSTEDT, Bacillar. (1930) 432, figs. 831, 832.

Valve lanceolate with parallel margins and acuminate ends. Length, 0.093 mm; breadth, 0.019. Costæ distinct, dilated at the margins, radiate at the ends. Not common. Reported from Kizaki and Biwa Lakes.

SURIRELLA BISERIATA Breb. var. CONSTRICTA Grun.

Surirella biseriata Breb. var. *constricta* Grun., FR. HUSTEDT, Bacillar. (1930) 433, fig. 835.

Valve constricted. Length, 0.098 mm; breadth, 0.02. Common. Known from Kizaki Lake.

SURIRELLA BISERIATA Breb. var. BIFRONS (Ehr.) Hust fo. HISPIDA Skvortzow.

Surirella biseriata Breb. var. *bifrons* (Ehr.) Hust. fo. *hispida* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 15, fig. 1.

Valve elliptic-lanceolate, broad, with acute ends. Length, 0.061 mm; breadth, 0.021. Pseudoraphe with distinct horns. Not common. Reported from Kizaki Lake.

SURIRELLA ELEGANS Ehr.

Surirella elegans Ehr., FR. HUSTEDT, Bacillar. (1930) 440, figs. 858, 859.

Valve elongate-ovate. One end much broader than the other. Length, 0.24 mm; breadth, 0.068. Costæ dilated at the margin, attenuate towards the pseudoraphe, 20 in 0.01 mm. Not common. Reported from Biwa Lake.

SURIRELLA ELEGANS Ehr. var. NORVEGICA (Eulenst.) Brun. Plate 3, fig. 1.

Surirella elegans Ehr. var. *norvegica* (Eulenst.) Brun, A. MAYER, Bacillar. d. Regensburger Gewässer (1912) 343, 344, pl. 23, fig. 1.

Larger and longer than the type. Length, 0.357 mm; breadth, 0.06. Costæ 10 in 0.01 mm, with intercostal striæ more or less evident. Striæ 20 to 25 in 0.01 mm. Common. Reported from Biwa Lake.

SURIRELLA TENUIS Mayer var. NIPPONICA var. nov. Plate 2, fig. 8.

Valve elongate-ovate, rounded at one end and acute at the other. Length, 0.032 mm; breadth, 0.0085. Costæ short or marginal, 40 in 0.01 mm. Differs from the type in its short and broad valves. Not common.

SURIRELLA TERRYANA Ward.

Surirella Terryana Ward, A. SCHMIDT, Atlas Diatom. (1912) pl. 280, figs. 7, 8.

Valve linear, with obtuse ends, parallel or slightly constricted margins. Length, 0.111 mm; breadth, 0.017. Common. Known from Kizaki and Aokiko Lakes.

SURIRELLA NIPPONICA Skvortzow.

Surirella nipponica SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 8, fig. 17.

Valve lanceolate, with attenuate ends. Length, 0.056 mm; breadth, 0.016. Costæ short, radiate, about 40 in 0.01 mm. Common. Reported from Kizaki and Biwa Lakes.

SURIRELLA OKAMURÆ sp. nov. Plate 2, figs. 10, 18, and 19.

Valve linear-elliptic, constricted on both sides and subrostrate at the ends. Length, 0.095 to 0.102 mm; breadth, 0.017 to 0.018. Central area linear. Costæ reaching the pseudoraphe, 6 to 7 in 0.01 mm. Outer rim distinct. A species related to *S. biwensis* Skv., from Biwa Lake, and *S. Heideni* Hust., from Tanganyika Lake, but not to *Cymatopleura solea* (Breb.) S. Smith.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Gomphonema globiferum* Meister.
2. *Navicula pupula* Kütz. var. *elliptica* Hust.
3. *Diploneis ovalis* (Hilse) Cleve.
4. *Gyrosigma Kützingii* (Grun.) Cleve.
5. *Cymbella alpina* Grun. fo. *nipponica* fo. nov.
6. *Synedra rumpens* Kütz. var. *Meneghiniana* Grun.
7. *Epithemia argus* Kütz. var. *alpestris* W. Smith.
8. *Gomphonema vastum* Hust. var. *maxima* Skv.
9. *Cymbella leptoceros* (Ehr.) Grun.
10. *Navicula Ikari* Skv. var. *nipponica* var. nov.
11. *Mastogloia elliptica* Agardh var. *dansei* (Thwaites) Grun.
12. *Navicula subtilissima* Cleve var. *Okamuræ* var. nov.
13. *Navicula tuscula* (Ehr.) Grun.
14. *Achnanthes linearis* W. Smith var. *nipponica* var. nov.
15. *Nitzschia denticula* Grun.
16. *Navicula hasta* Pant. fo. *minor* fo. nov.

FIGS. 17. and 18. *Navicula ventralis* Krasske var. *Okamuræ* var. nov.

FIG. 19. *Navicula atomarius* Skv.
20. *Achnanthes linearis* W. Smith var. *nipponica* var. nov.
21. *Navicula hungarica* Grun. var. *capitata* (Ehr.) Cleve.
22. *Navicula falaisiensis* Grun. var. *lanceola* Grun.
23. *Navicula minima* Grun. var. *Okamuræ* var. nov.
24. *Cymbella turgidula* Grun.
25. *Achnanthes Okamuræ* sp. nov.
26. *Rhopalodia gibberula* (Ehr.) O. Müll. var. *Van Heurcki* O. Müll.
27. *Gomphonema augur* Ehr. var. *Gautieri* Van Heurck.
28. *Nitzschia frustulum* (Kütz.) Grun. var. *perpusilla* (Rabh.) Grun.
29. *Diploneis puella* (Schum.) Cleve.
30. *Cymbella turgida* (Greg.) Cleve fo. *minor* fo. nov.
31. *Nitzschia amphibia* Grun.
32. *Amphora normani* Rabh.

PLATE 2

FIG. 1. *Neidium affine* (Ehr.) Cleve var. *amphirhynchus* (Ehr.) Cleve.
2. *Anomœoneis exilis* (Kütz.) Cleve var. *lanceolata* A. Mayer.
3. *Amphipleura pellucida* Kütz. var. *recta* Kitton.
4. *Gyrosigma acuminatum* (Kütz.) Rabh.
5. *Pinnularia borealis* Ehr.
6. *Pinnularia Hustedti* Meister var. *nipponica* var. nov.
7. *Pinnularia gibba* Ehr. var. *Okamuræ* var. nov.
8. *Surirella tenuis* Mayer var. *nipponica* var. nov.
9. *Achnanthes Kizaki* Skv.

FIG. 10. *Surirella Okamuræ* sp. nov.
11. *Nitzschia tryblionella* Hantz. var. *Victoriæ* Grun.
12. *Navicula anglica* Ralfs.
13. *Melosira islandica* O. Müll. subsp. *helvetica* O. Müll.
14. *Frustulia rhomboides* (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *capitata* A. Mayer.
15. *Navicula lanceolata* (Agardh) Kütz.
16. *Neidium dubium* (Ehr.) Cleve fo. *constricta* Hust.
17. *Pinnularia borealis* Ehr.

FIGS. 18 and 19. *Surirella Okamuræ* sp. nov.

PLATE 3

FIG. 1. *Surirella elegans* Ehr. var. *norvegica* (Eulenst.) Brun.
2. *Rhopalodia parallela* (Grun.) Müll.
3. *Hantzschia amphioxys* (Ehr.) Grun. var. *vivax* (Hantzsch) Grun.
4. *Pinnularia kiusiuensis* sp. nov.
5. *Gyrosigma Spenceri* (W. Smith) Cleve var. *Okamuræ* var. nov.
6. *Surirella robusta* Ehr. var. *Okamuræ* var. nov.
7. *Gomphonema intricatum* Kütz.
8. *Eunotia flexuosa* Kütz.
9. *Nitzschia Okamuræ* sp. nov.
10. *Gyrosigma Spenceri* (W. Smith) Cleve var. *Okamuræ* var. nov.
11. *Pinnularia microstauron* (Ehr.) Cleve.
12. *Synedra amphicephala* Kütz.
13. *Gomphonema puiggarianum* Grun.

PLATE 4

FIG. 1. *Cymbella aspera* (Ehr.) Cleve.
2. *Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun.
3. *Surirella robusta* Ehr. var. *splendida* (Ehr.) Van Heurck fo. *nipponica* fo. nov.
4. *Neidium iridis* (Ehr.) Cleve var. *amphigomphus* (Ehr.) Van Heurck fo. *angusta* fo. nov.
5. *Navicula halophila* (Grun.) Cleve var. *Okamuræ* var. nov.
6. *Eunotia tenella* (Grun.) Hust.
7. *Gomphonema Ikeda* sp. nov.
8. *Pinnularia lignitica* Cleve.
9. *Navicula cuspidata* Kütz.

FIGS. 10 and 11. *Synedra rumpens* Kütz. var. *Okamuræ* var. nov.

FIG. 12. *Frustulia rhomboides* (Ehr.) de Toni var. *amphipleuroides* Grun.
13. *Gomphonema augur* Ehr. var. *Okamuræ* var. nov.

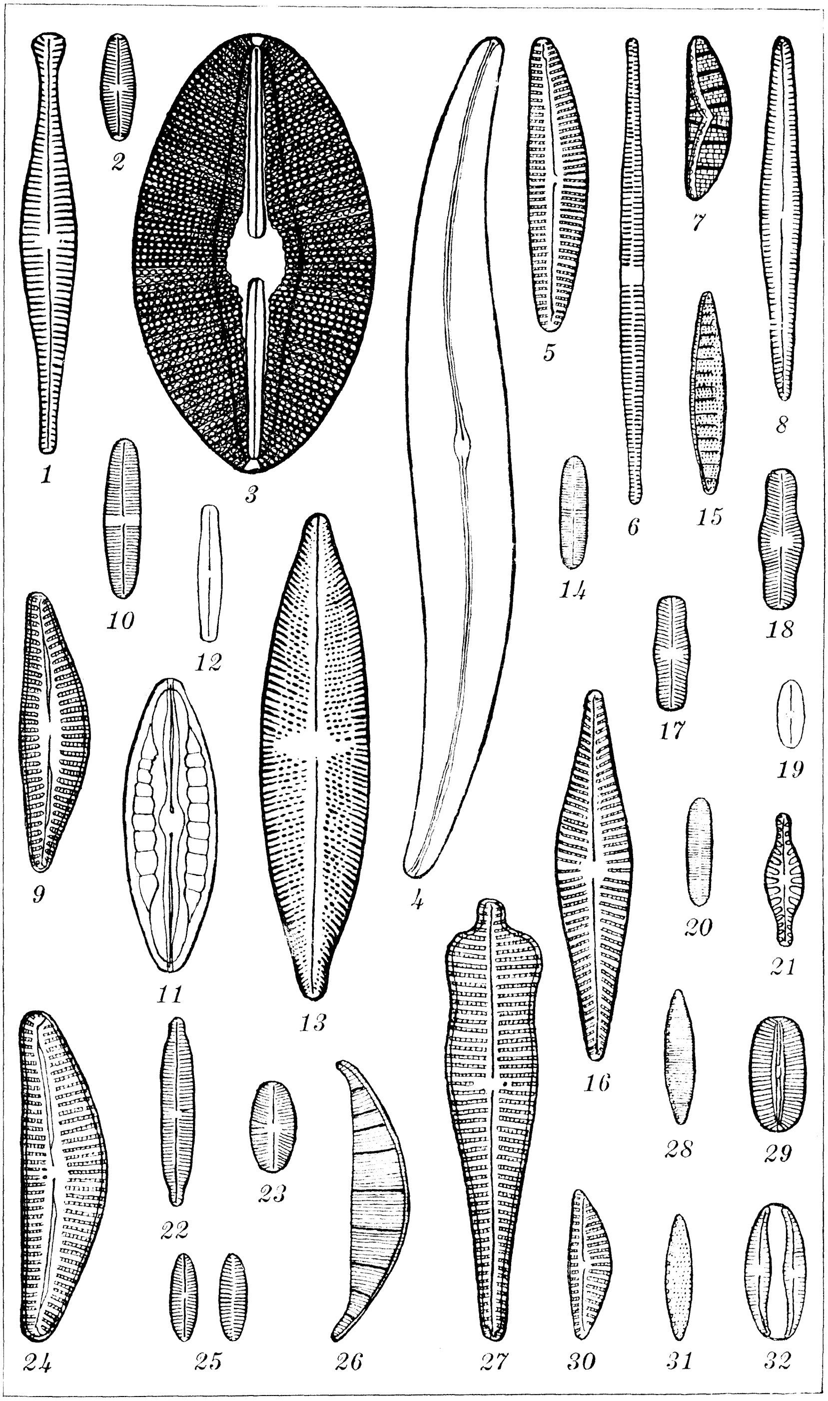
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PLATE 1.

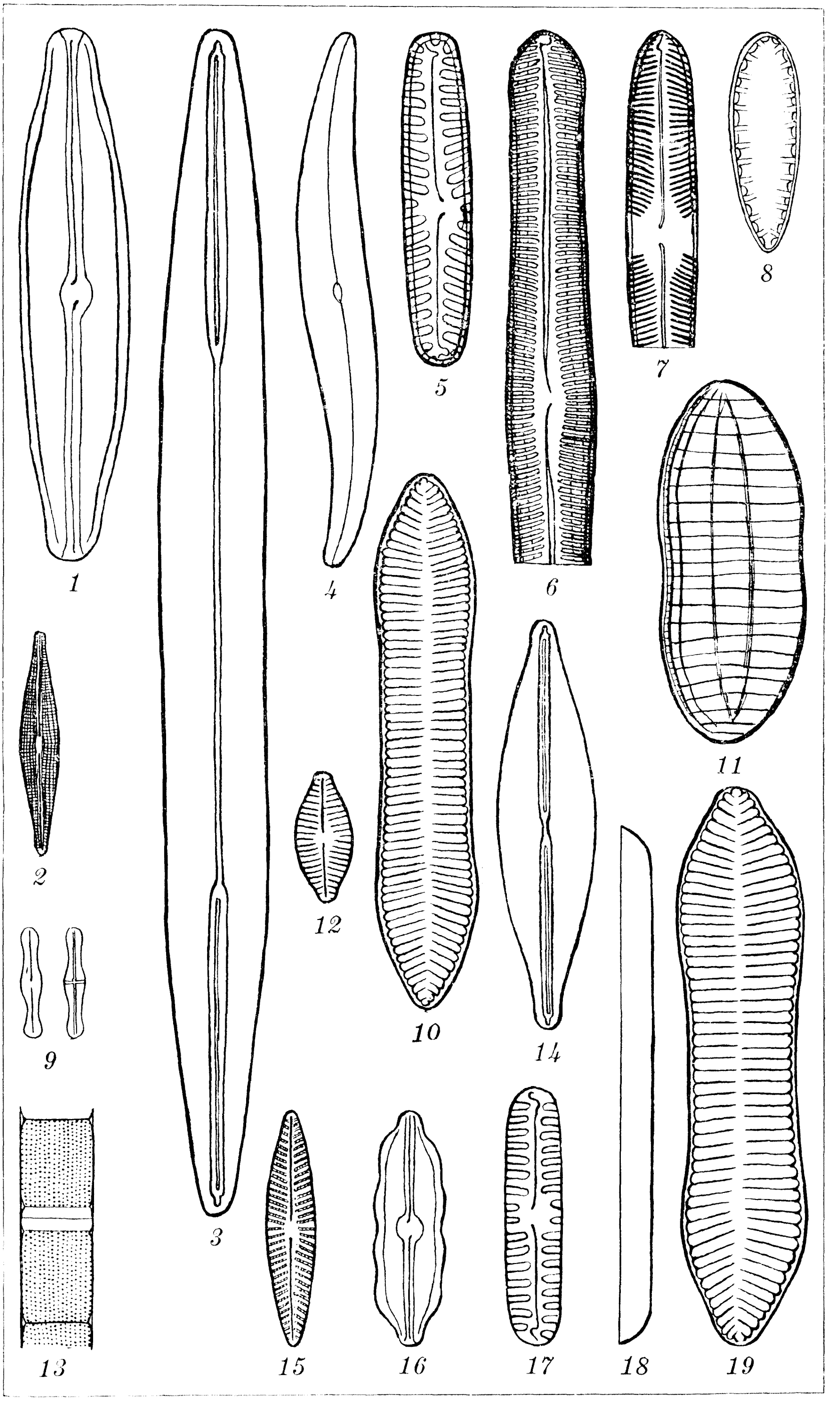

PLATE 2.

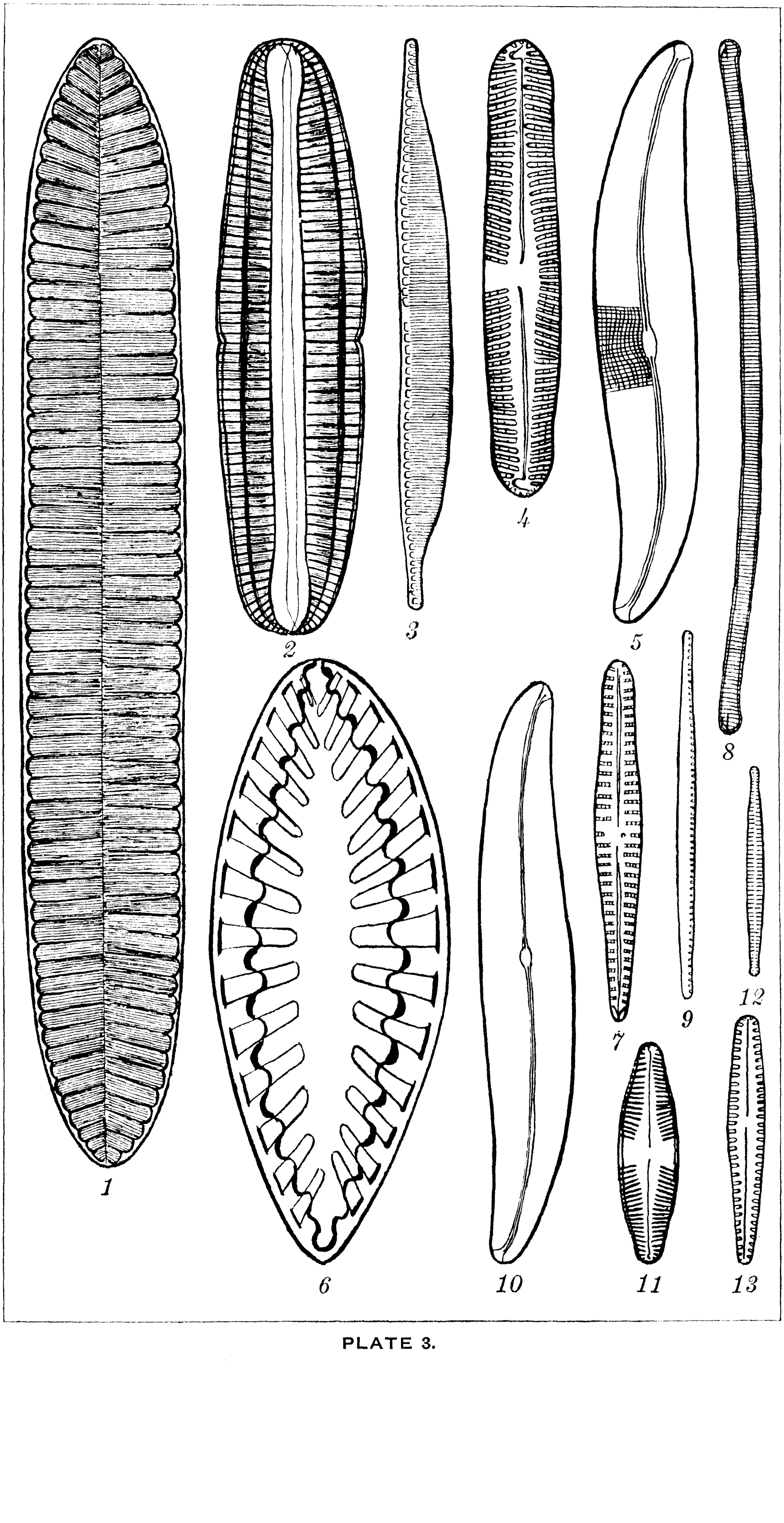

PLATE 3.

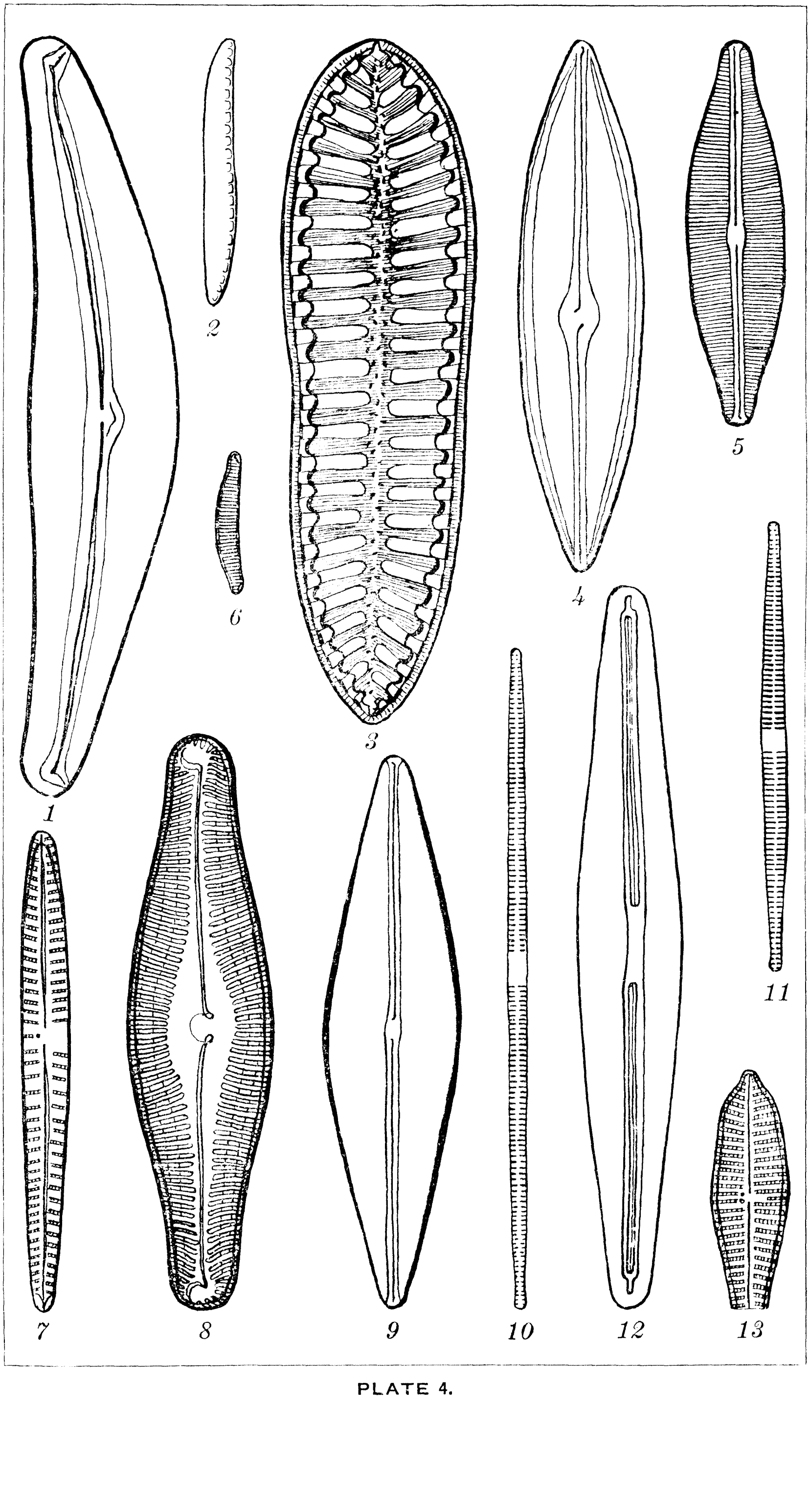

PLATE 4.

FIVE SPECIES OF PHILIPPINE SHRIMPS OF THE GENUS PENÆUS

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Of the Fish and Game Administration, Bureau of Science, Manila

THREE PLATES

This paper presents a systematic study of five commercial species of shrimps locally known as *hipon, pasayan,* and *sugpô* (Tagalog); *padao* or *pasayan* (Ilocano); and *locon* or *balusugay* (Visayan).

The commercial possibilities of the shrimp fisheries of the Philippines are still undetermined. The fresh shrimps found in the local markets are supplied mostly from the catches of the beam trawls in Manila Bay, Lingayen Gulf, and Malampaya Sound, and from fishponds in various parts of the Philippines. Shrimps are also caught in fish corrals.

The amount of fresh shrimps landed at Manila from January to November, 1934, was 322,818 kilograms, a monthly average of 35,868.66 kilograms. The estimated value of the shrimps is 129,127.20 pesos [1] for the year, an average of 14,347 pesos per month. In 1935 the amount was 494,182 kilograms, a monthly average of 41,181 kilograms. The estimated value of the shrimps caught in 1935 is 177,672.80 pesos, a monthly average of 14,806 pesos. These shrimps come from Manila Bay, Lingayen Gulf, Malampaya Sound, and Ragay Gulf. Table 1 shows the amount of fresh shrimps landed in Manila during 1934 and 1935. The total value of the fresh shrimps caught in the Philippines even for the last two years is still undetermined.

The shrimp industry in the Philippines has great commercial possibilities, and its development deserves serious study. More fishing grounds for shrimps should be located along the shores, bays, and estuaries, and better methods of catching these crustaceans should be introduced. Nets of larger capacity, 100 to 500 feet in length, should be used to bring in commercial catches.

[1] One peso Philippine currency equals 50 cents United States currency.

TABLE 1.—*Weight in kilograms of fresh shrimps landed at Manila during 1934 and 1935.*

Month.	1934 Kg.	1935 Kg.
January	24,651	24,060
February	28,710	29,825
March	40,240	30,459
April	31,178	32,001
May	35,642	35,149
June	4,355	30,459
July	31,393	37,811
August	35,746	44,047
September	33,229	53,146
October	32,443	62,318
November	25,231	53,842
December	....	61,065
Total	322,818	494,182

At present five common and important species are found in the commercial catches of shrimps; namely, *Penæus canaliculatus* Olivier, *P. affinis* Milne-Edwards, *P. incisipes* Bate, *P. indicus* Milne-Edwards, and *P. monodon* Fabricius.

PENEIDÆ

Rostrum well developed, laterally compressed, sometimes short and elevated, often toothed, rostral lateral sulci long or short and deeply grooved. Antennules with two flagella; basal joint of peduncle dorsally concave for eye. Mandible with incisor process, with palp of one or two segments. First three pairs of legs similar, chelate, and slender; last two pairs well developed.

Genus PENÆUS Fabricius

Rostrum toothed above and below or fringed with hairs inferiorly. Outer edge of basal joint of antennular peduncle produced into anterior spine; antennular flagella shorter than carapace. Mandibular palp large and foliaceous, 2-jointed, second segment larger than first. Exopodites on first to fourth leg. Dorsal surface of three abdominal somites with keellike ridge. First, second, and third legs with pincers.

Key to the five species of Penæus in the Philippines.

a.[1] Lateral rostral sulci extending to posterior margin of carapace; rostral formula $\frac{11-12}{1}$; lower and last upper anterior tooth opposite.

P. canaliculatus.

a.[2] Lateral rostral sulci not extending to posterior margin of carapace.

b.[1] Rostrum with no crest; ventral margin fringed with hairs, no teeth.

c.[1] Rostral formula $\frac{9\text{–}11}{0}$; slightly turned upward on tip; usually the first two teeth on carapace .... *P. affinis.*

c.[2] Rostral formula $\frac{8\text{–}11}{0}$; rostrum narrow, straight; carapace rough. *P. incisipes.*

b.[2] Rostrum with crest; ventral margin with 3 to 5 teeth.

c.[1] Rostral formula $\frac{7\text{–}8}{4\text{–}5}$; rostrum broadly arched, abruptly thinned, tapering anteriorly .... *P. indicus.*

c.[2] Rostral formula $\frac{6\text{–}7}{3}$; rostrum straight, laterally compressed. *P. monodon.*

PENÆUS CANALICULATUS Olivier. Plate 1, figs. 1 to 3.

Penæus canaliculatus OLIVIER, Encyc. Method 8 (1811) 660;[2] MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 414; BATE, Crustacea Macrura. Challenger Zool. 24 (1873–1876) 243–245, pl. 32, figs. 1, 2; Ann. & Mag. Nat. Hist. V 8 (1881) 174–175.

Rostrum straight, slightly elevated, reaching just beyond the tip of antennular peduncle; rostral formula $\frac{11\text{–}12}{1}$; 11 to 12 teeth on the upper margin of rostrum, 4 or 5 on the carapace; inferior margin with one tooth, below the last anterior tooth of the upper margin. Lateral rostral sulci extending on nearly entire length of posterior margin of carapace. Last three pleural somites compressed and dorsally keeled. Telson without spines, apex acuminate, fringed with hairs at the sides, dorsal median line grooved to the apex.

TABLE 2.—*Length and rostral formula of Penæus canaliculatus Olivier, all from Bantayan, Bantayan Island, Cebu Province, January 1, 1929.*

Serial No.	Sex.	Length.	Rostral formula.	Serial No.	Sex.	Length.	Rostral formula.
		cm.				*cm.*	
1	♀	10.8	$\frac{1}{1}$	6	♀	9.6	$\frac{12}{1}$
2	♀	10.7	$\frac{11}{1}$	7	♀	9.1	$\frac{12}{1}$
3	♀	11.2	$\frac{12}{1}$	8	♀	10.5	$\frac{11}{1}$
4	♀	9.7	$\frac{11}{1}$	9	♂	11.8	$\frac{11}{1}$
5	♀	12.5	$\frac{12}{1}$	10	♀	9.9	$\frac{12}{1}$

[2] Not in the Scientific Library, Philippine Bureau of Science, Manila.

Ten specimens, 9.1 to 12.5 cm long (Table 2).

BANTAYAN ISLAND, Cebu Province, Bantayan, January 1, 1929.

PENÆUS AFFINIS Milne-Edwards. Plate 1, fig. 4.

Penæus affinis MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 416; BATE, Ann. Mag. Nat. Hist. V 8 (1881) 179, pl. 12, fig. 6; ORTMANN, Zool. Jahrb. Syst. 5 (1890) 450; HENDERSON, Trans. Linn. Soc. 2d ser. Zool. 5 (1893) 448; KISHINOUYE, Journ. Fish. Bur. 8 (1900) 16, pl. 7, fig. 5, *5a;* NOBILI, Bull. Mus. Torino 28 (1903) 2.[3]

Metapenaeus affinis ALCOCK, Indian Mus., Macrura pt. 3 (1906) 20–21, pl. 3, figs. 8, *8a, b.*

Rostrum slender, no crest, slightly turned upwards at the extremity; rostral formula $\frac{9\text{–}11}{0}$; 9 to 11 teeth on upper border of rostrum, 2 teeth always on the carapace; inferior margin without a tooth, instead fringed with hairs. First pair of antennal peduncle on level with the tip of the rostrum. Flagella of second pair of antennæ $4\frac{1}{3}$ times as long as body. Lateral rostral sulci on the level of the last posterior tooth on the carapace. Thelycum setose; its lateral lobes flattish and transversely cut into two unequal parts. Last pair of thoracic legs in both sexes longer than the tip of the antennal scale by the length of the dactylus. Telson shorter than internal plate of uropod.

TABLE 3.—*Length and rostral formula of Penæus affinis Milne-Edwards.*

Serial No.	Sex.	Length.	Rostral formula.	Locality.
		cm.		
1	♀	10	$\frac{9}{0}$	Luzon, Ilocos Norte Province, Caaoacan River, Laoag, August 17, 1933.
2	♀	8	$\frac{9}{0}$	Do.
3	♀	10.2	$\frac{10}{0}$	Luzon, Cagayan Province, Aparri, May 22, 1923.
4	♀	10.5	$\frac{9}{0}$	Do.
5	♀	10	$\frac{10}{0}$	Do.
6	♀	9.2	$\frac{10}{0}$	Manila, Paco market, April 1, 1931.
7	♀	8.5	$\frac{9}{0}$	Do.
8	♂	8.6	$\frac{10}{0}$	Luzon, Camarines Sur Province, San Miguel Bay, September 25, 1924.
9	♂	6.4	$\frac{10}{0}$	Luzon, Bicol Provinces, Loay, November 19, 1926.
10	♂	10.9	$\frac{10}{0}$	Do.
11	♂	9	$\frac{11}{0}$	Do.

[3] See footnote 2.

Eleven specimens, 6.4 to 10.9 cm long (Table 3).

LUZON, Ilocos Norte Province, Caaoacan River, Laoag, August 17, 1933: Cagayan Province, Aparri, May 22, 1923: Manila, Paco market, April 1, 1931: Camarines Sur Province, San Miguel Bay, September 25, 1924: Bicol Provinces, Loay, November 19, 1926.

PENÆUS INCISIPES Bate. Plate 2, fig. 5.

Penæus incisipes BATE, Crustacea Macrura. Challenger Zool. 24 (1873–1876) 257–258, pl. 34, fig. 2.

Rostrum narrow, straight, slightly elevated. Rostral formula $\frac{8\text{–}11}{0}$; 8 to 11 teeth on the upper margin of rostrum, 2 teeth on the carapace, inferior margin fringed with hairs, carapace rough. Lateral rostral sulci terminating on level with the last posterior teeth on the carapace. Flagella of first pair of antennæ as long as the peduncle; flagella of the second pair of antennæ three times as long as the body. Chelæ long and slender, dactylus flattened, merus notched under. Petasma on the first pair of pleopod in male, long, narrow, and double-headed on extremity. Telson shorter than the plates of the uropod.

TABLE 4.—*Length and rostral formula of female Penæus incisipes Bate, all from Limay, Bataan Province, Luzon.*

Serial No.	Length.	Rostral formula.	Serial No.	Length.	Rostral formula.	Serial No.	Length.	Rostral formula.
	cm.			*cm.*			*cm.*	
1	11.3	$\frac{10}{0}$	9	7.3	$\frac{10}{0}$	17	13.2	$\frac{10}{0}$
2	11	$\frac{10}{0}$	10	8.9	$\frac{10}{0}$	18	12.4	$\frac{10}{0}$
3	9.9	$\frac{9}{0}$	11	8.1	$\frac{9}{0}$	19	13.9	$\frac{8}{0}$
4	11.1	$\frac{8}{0}$	12	9.6	$\frac{10}{0}$	20	11.5	$\frac{10}{0}$
5	11	$\frac{9}{0}$	13	8.6	$\frac{10}{0}$	21	12.6	$\frac{11}{0}$
6	10.3	$\frac{11}{0}$	14	7.7	$\frac{9}{0}$	22	12.7	$\frac{9}{0}$
7	8.9	$\frac{9}{0}$	15	12.3	$\frac{10}{0}$	23	10.8	$\frac{9}{0}$
8	8.8	$\frac{10}{0}$	16	14.9	$\frac{9}{0}$	24	12.5	$\frac{10}{0}$

Twenty-four female specimens, 7.3 to 14.9 cm long (Table 4).

LUZON, Bataan Province, Limay, November 22, 1934.

PENÆUS INDICUS Milne-Edwards. Plate 2, figs. 6 and 7.

Penæus indicus MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 415; BATE, Ann. and Mag. Nat. Hist. V 8 (1881) 177, pl. 12, fig. 5; Crustacea Macrura. Challenger Zool. 24 (1873–1876) 248–249.

Rostrum straight; rostral crest decreasing gradually towards the posterior margin of the carapace. Rostral formula $\frac{7-8}{4-5}$; 7 to 8 teeth on the upper margin of the rostrum, 3 teeth on the carapace; that of the lower margin of the rostrum with 4 to 5 teeth. Lateral rostral sulci not extending beyond the last posterior teeth. Telson acuminate with a median dorsal longitudinal groove. Outer plates of uropods $1\frac{1}{4}$ times as long as telson.

TABLE 5.—*Length and rostral formula of Penæus indicus Milne-Edwards.*

Serial No.	Sex.	Length.	Rostral formula.	Locality.
		cm.		
1	♀	15.1	$\frac{7}{4}$	Luzon, Manila Bay, November 13, 1936.
2	♀	15.4	$\frac{7}{4}$	Do.
3	♀	15.6	$\frac{7}{4}$	Do.
4	♀	14.2	$\frac{7}{4}$	Do.
5	♂	14.3	$\frac{8}{4}$	Do.
6	♀	14.3	$\frac{8}{4}$	Luzon, Manila, October 12, 1911.
7	♀	12.2	$\frac{7}{4}$	Luzon, Bulacan Province, Malolos, September 4, 1927.
8	♀	11.3	$\frac{7}{4}$	Luzon, Bulacan Province, Santa Cruz, Paombong, April 22, 1927.
9	♀	10.8	$\frac{7}{5}$	Do.
10	♀	11.1	$\frac{7}{4}$	Do.
11	♀	15.6	$\frac{8}{4}$	Do.

Eleven specimens (Table 5).

LUZON, Manila Bay, November 13, 1934, Manila, October 12, 1911: Bulacan Province, Malolos, September 4, 1927; Santa Cruz, Paombong, April 22, 1927.

PENÆUS MONODON Fabricius. Plate 3.

Penæus monodon FABRICIUS, Ent. Syst. Suppl. (1798) 408; MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 416; STIMPSON, Proc. Acad. Sci. Phila. (1860) 44;[4] HELLER, Novara Crust. (1868) 122; BATE, Ann. & Mag. Nat. Hist. V 8 (1881) 178, pl. 11, Challenger Rept. Zool. 24 (1873–1876) 250–252; ALCOCK, Cat. Indian Decapod Crust. Indian Mus. pt. 3 (1906) 8–10, pl. 1.

[4] See footnote 2.

Penæus semisulcatus DE HAAN, Fauna Japonica de von Siebold Crust. (1850) 191, pl. 46, fig. 1.

Penæus carinatus DANA, Crustacea U. S. Explor. Exped. pt. 1 13 (1852) 602, pl. 11, fig. 2;[5] WALKER, Journ. Linn. Soc. Zool. 20 (1887) 112.

Penæus ashiaka KISHINOUYE, Journ. Fish. Bur. 8 (1900) 7, 14, pl. 3; NOBILI, Bull. Mus. Torino 18 (1903) 2.[5]

Rostrum straight, dorsally elevated into a laterally compressed crest. Rostral formula $\frac{6\text{–}7}{3}$; 6 to 7 teeth on the upper margin of the rostrum, 3 of them on the carapace; lower edge with 3 teeth. Rostral crest gradually lessens behind the last teeth on the carapace. Lateral rostral sulci on both sides of dorsal crest formed by longitudinal ridge that commences from the apex of the rostrum, and terminates at a line on the level of the posterior tooth of the crest. Antennular scales reach beyond the eyes; outer longer antennular flagellum shorter than its peduncle. Petasma symmetrical, consisting of two opposing

TABLE 6.—*Length and rostral formula of Penæus monodon Fabricius.*

Serial No.	Sex.	Length.	Rostral formula.	Locality.
		cm.		
1	♀	14.9	$\frac{7}{3}$	Luzon, Pangasinan Province, Lingayen Gulf, Dagupan, October 3, 1934.
2	♂	13.2	$\frac{7}{3}$	Do.
3	♂	13.0	$\frac{7}{3}$	Luzon, Manila Bay, November 30, 1934.
4	♂	12.1	$\frac{7}{3}$	Do.
5	♂	13.9	$\frac{7}{3}$	Do.
6	♂	11.7	$\frac{7}{3}$	Do.
7	♂	14.4	$\frac{7}{3}$	Do.
8	♀	13.9	$\frac{7}{3}$	Do.
9	♂	12.7	$\frac{7}{3}$	Do.
10	♀	17.2	$\frac{7}{3}$	Luzon, Ilocos Sur Province, Vigan, May 31, 1923.
11	♀	17.0	$\frac{7}{3}$	Do.
12	♀	14.2	$\frac{7}{3}$	Do.

[5] See footnote 2.

simple lobes, forming a tube. The 4th to 6th abdominal somites carinated in the middle line. The lateral borders of the telson without spines.

Twelve specimens of both sexes, 11.7 to 17.2 cm long (Table 6).

LUZON, Pangasinan Province, Lingayen Gulf, Dagupan, October 3, 1934: Manila Bay, November 30, 1934: Ilocos Sur Province, Vigan, May 31, 1923.

ILLUSTRATIONS

(Drawings by Angel D. Lagman.)

PLATE 1

FIG. 1. *Penæus canaliculatus* Olivier; lateral view of head, natural size.
2. *Penæus canaliculatus* Olivier; dorsolateral view of telson and uropods, natural size.
3. *Penæus canaliculatus* Olivier; dorsal view of carapace, natural size.
4. *Penæus affinis* Milne-Edwards; lateral view of head, natural size.

PLATE 2

FIG. 5. *Penæus incisipes* BATE; lateral view of head, natural size.
6. *Penæus indicus* Milne-Edwards; lateral view of head, natural size.
7. *Penæus indicus* Milne-Edwards; dorsal view of telson, natural size.

PLATE 3

Penæus monodon Fabricius; natural size.

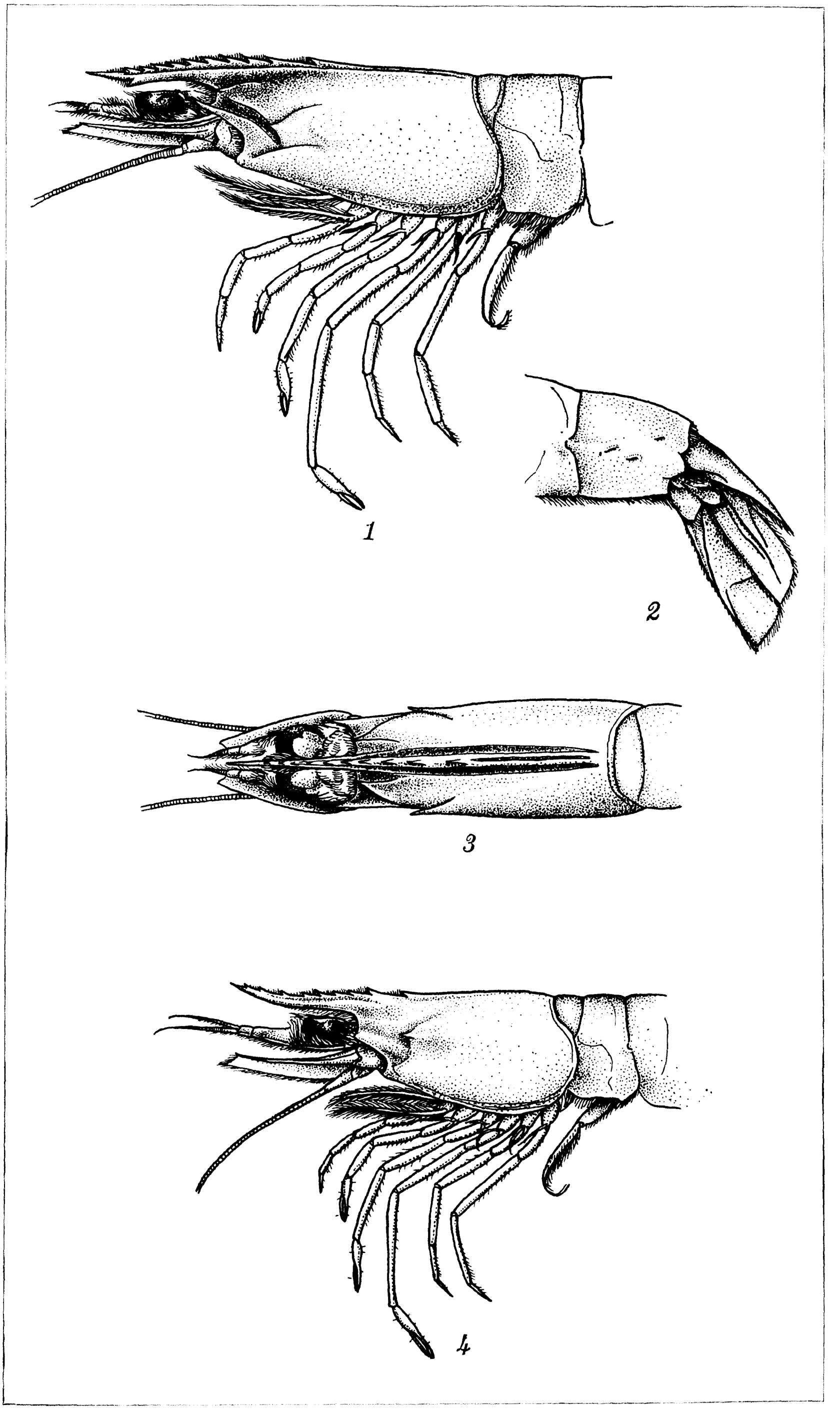

PLATE 1.

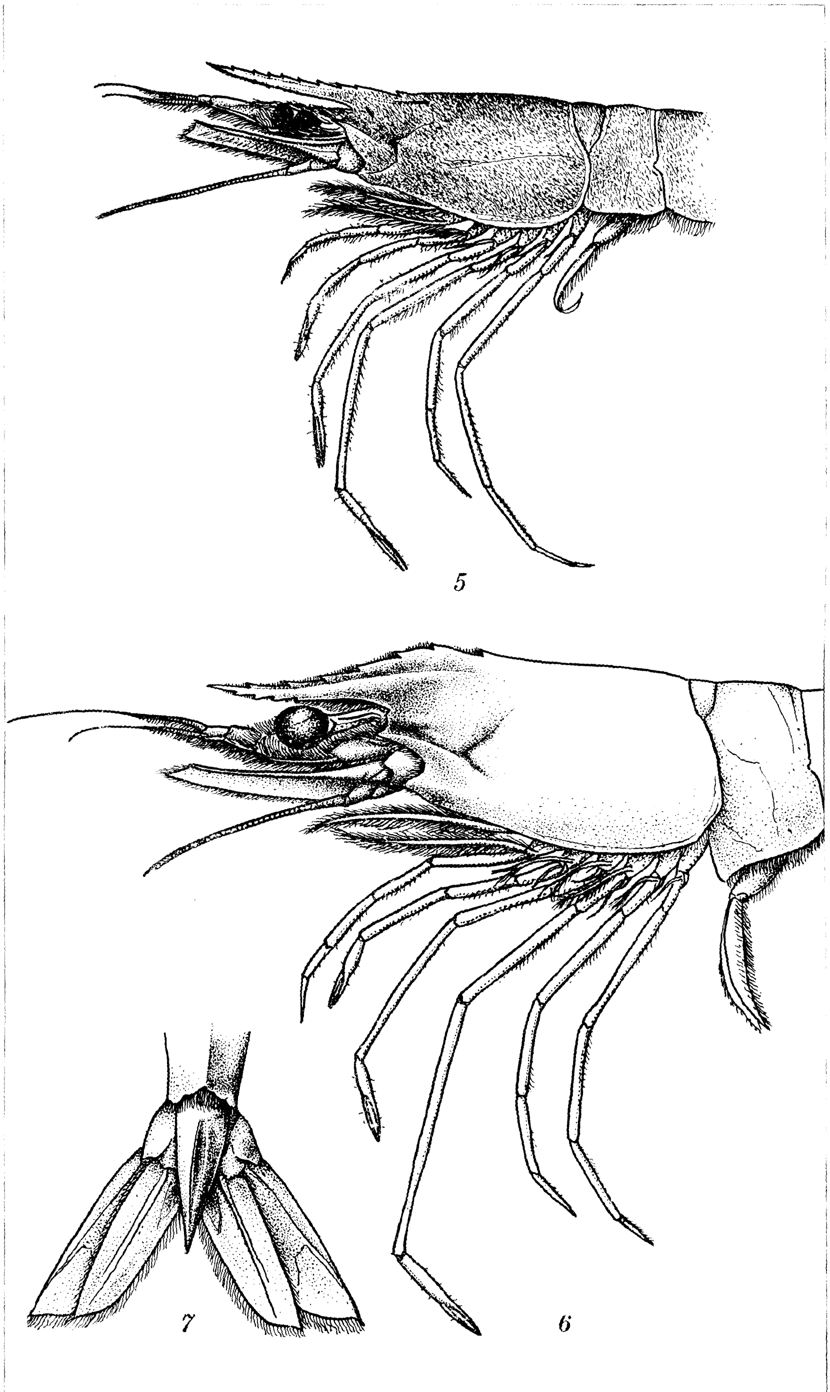

PLATE 2.

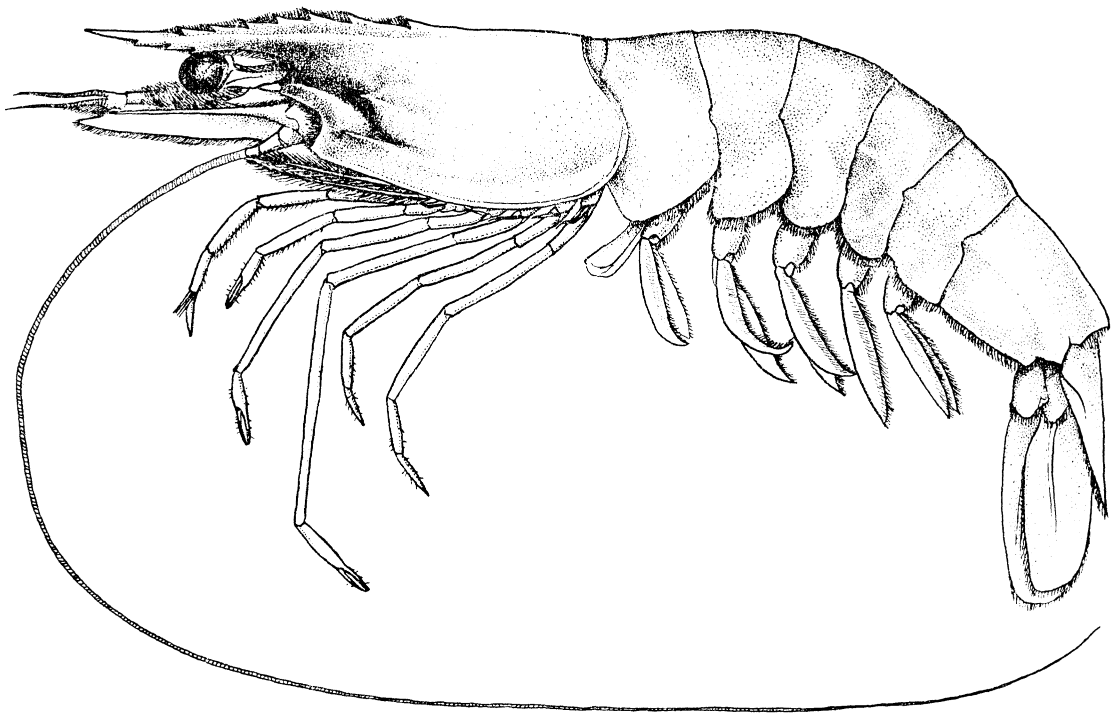

PLATE 3.

THE ARTIFICIAL FERTILIZATION OF DANGIT, AMPHACANTHUS ORAMIN (BLOCH AND SCHNEIDER)

By PORFIRIO R. MANACOP
Of the Fish and Game Administration, Bureau of Science, Manila

ONE PLATE

Amphacanthus oramin (Bloch and Schneider) is, in some localities of the Philippines, considered an important food fish. It is commonly known as *dangit* in the Visayan Provinces; as *barawis, turus,* and *batawayi* in the Bicol Provinces; as *barañgan* or *malaga* in the Ilocano Provinces; and as *samaral* in the Tagalog Provinces. It is caught principally in shallow-water fish corrals. The most important fishing centers of dangit are: Murcielagos Bay; the northern, western, and southwestern parts of Bohol; Bantayan Island, Cebu; the coasts of Sorsogon and Camarines Sur; a number of municipalities in the Ilocos Provinces; and in the Calatagan Peninsula, Batangas Province. Bantayan, Bantayan Island, Cebu, is probably the most important fishing center for dangit in the entire Philippine Archipelago.

The dangit is caught in large quantities during the fishing season, from January to April around Bantayan Island and Murcielagos Bay, and from January to February around Tagbilaran, Bohol. Often the catch is so large that thousands of fish are dried and marketed in a salted state in the neighboring inland towns. The roe and fry (*kuyug*) of dangit are also collected and preserved in a salted state, and are considered a delicacy in the Visayan Islands and the Bicol Provinces. Because of the enormous yearly catches of both the mature and the young, the eventual depletion of this fish in shallow waters is not improbable, due largely to its habit of ovipositing in shallow waters, especially in and around fish corrals, where the eggs are subject to wholesale destruction.

The natural destruction of the eggs apparently is large, since they are laid on the bottom. The principal loss is through thoughtless trampling by the fishermen brailing their catch from the terminal pound (*bunuan*) of the fish corral. The operation

of fine-meshed *sinamay* seines (*baling* and *baling-baling*) on the spawning grounds also causes the destruction of enormous numbers of eggs, which are covered or pressed by the bottom line of these drag seines. Probably some of the eggs are fed upon by numerous animals, including fish. Failure of fertilization of the eggs is another cause of loss.

This paper is a preliminary report on the artificial fertilization of *Amphacanthus oramin.* If artificial propagation of this species proves possible, the eggs can be hatched on a large scale, and the dangit fishery, which has been apparently declining during recent years, maintained and rehabilitated. This work was done in Murcielagos Bay during the spawning run of March 28, 1936, and again in Tagbilaran, Bohol, in April of the same year.

SPAWNING

The peak of the spawning activity of the dangit in Murcielagos Bay and in Bantayan, Bantayan Island, Cebu, is from January to April. In Tagbilaran and vicinity, Bohol, however, it occurs during January and February. The dangit spawns at a minimum length of 9 centimeters for the male and 12 centimeters for the female.

Spawning takes place from the fourth to the seventh night after the appearance of the new moon in Bantayan, Bantayan Island, Cebu. In Murcielagos Bay and Tagbilaran, Bohol, however, the spawning period usually lasts only for two days, seldom for three, beginning on the fifth day after the new moon. The fish come in large schools to shallow tidal flats as the tide begins to rise, and spawning begins after midnight, when the tide begins to recede, and lasts until dawn.

The dangit appears to pair during the spawning run. The eggs, which are deposited by the females on the bottom, are probably fertilized by the chasing male as he passes over them. The pairing of the fish and the impounding of the school of spawning dangit in the terminal crib, or pound, bring the sexual elements in close proximity, insuring fertilization and consequently a high percentage of hatching.

The dangit is one of the most prolific fishes. The number of eggs laid by a 21.4-centimeter female (total length) in a spawning act is estimated at about 419,000. A female of a total length of 16.4 centimeters was found to have spawned at one time about 363,000 ova. This number was approximated by dividing the total weight of a pair of ovaries that had been preserved in 5

per cent formalin by the weight of a known number of eggs taken from a ripening ovary, and then multiplying the quotient by the number of eggs weighed.

ARTIFICIAL FERTILIZATION

Methods and equipment.—Two methods of fertilization were employed; namely, dry and wet. In the dry method the fertilization dish, a finger bowl, was merely moistened with sea water before the eggs and milt were stripped into it. In the wet method the eggs and milt were stripped into the fertilization bowl half-filled with sea water.

In both methods the procedure of stripping the fish was as follows: A ripe female was taken with the left hand and held firmly by the head. The vent was held quite close to the fertilization dish in order to avoid injury to the delicate eggs. Then the right hand was repeatedly smoothed down from the pectoral region towards the vent of the fish until sufficient eggs were obtained.

By the same procedure one or two ripe males were taken and stripped of their milt into the bowl of eggs. Whenever an insufficient amount of milt was taken in one stripping the fish was laid on its side. After about half an hour it was stripped again. The milt from one or two ripe males was often enough to cover and fertilize the eggs from an average female.

Great caution should be observed in stripping, especially when the fish is taken alive. The wounds often inflicted by the sharp dorsal and pelvic spines produce agonizing pain, and the bleeding from them might interfere with the fertilization of the eggs.

The eggs and milt collected in the fertilization dish were carefully mixed and stirred with a hen's feather. The mixture was constantly stirred for from ten to fifteen minutes, after which the eggs were rinsed of the excess milt, thoroughly washed by pouring in fresh salt water, which was decanted repeatedly until the water in the fertilization dish was clear.

As there was no hatching apparatus, finger bowls and petri dishes were used for hatching. To provide constant aëration, the water in the hatching dishes was changed as often as possible until the end of the incubation period.

To obviate the difficulty or inconvenience in aërating the eggs by frequent changing of the water, a live or hatching box was constructed in Tagbilaran, Bohol, during the spawning run of April 27–28, 1936. The hatching box consisted of an ordinary wooden box ($50 \times 30 \times 20$ cm) provided with a bamboo float

on each side, and the bottom covered with a fine organic cloth. It was set out in the sea and tied at one end to a pole staked into the sand.

The artificial impregnation of the eggs was carried out in the fishing ground. The eggs and milt were stripped from the fish as the latter were taken from the bunuan of the fish corral. The impregnated eggs, after having been thoroughly washed of the excess milt and fairly hardened, were transferred to the hatching box. Their development was observed in the laboratory under a compound microscope.

RESULTS AND DISCUSSION

The dangit are not sexually dimorphic; nevertheless, during the breeding season the sexes may be readily distinguished and separated by the following criteria:

1. The males are generally smaller than the females. Mature males are from 11 to 14 centimeters long and mature females from 13 to 21 centimeters.
2. The abdominal region of the females is more distinctly plump and enlarged than that of the male on account of the ripening ovary.
3. The genital aperture of the female is more enlarged than that of the male for the free passage of the ripe eggs.
4. When slight pressure is applied on the vent region, ripe, orange-colored eggs come out from the female and white milt from the male.
5. In the water the female is less active than the male because of the weight of the ripe eggs.

After stripping a large number of females during the spawning run of March, 1936, two distinct groups of eggs were noted: The ripe eggs are translucent orange, perfectly spherical, demersal and adhesive (Plate 1, fig. 2). They have the tendency to stick or clump together upon the walls of the hatching glass vessel. The reticulated structure of the egg membrane (Plate 1, fig. 2) probably accounts for its adhesive property. The eggs measure about 0.7 millimeter in diameter. At this size most of them are free in the lumen of the ovary and are ready to be spawned, hence they are easy to expel. These eggs flow in a stream from the vent of the fish as the latter is stripped. They are usually encountered during the fifth and sixth nights of the spawning run. During this time also most of the fish caught and examined were ripe and ready for spawning.

The unripe eggs (Plate 1, fig. 1) are usually met with in stray spawners, which appear in the catch of the fish corral, mixed with other fishes, a few days prior to the actual date of the run. However, very few fish bear this kind of eggs. The eggs are characterized by being orange, opaque, quite hard to strip, and flow in clots when stripped.

As to the relative efficacies of the dry and wet methods of impregnation, nothing definite has been determined. In both methods few eggs were hatched, possibly due to poor aëration, the eggs having been hatched only in open finger bowls and petri dishes where a continuous circulation of water was not obtainable. In spite of the frequent changing of the water in these simple hatching dishes to provide sufficient aëration, the eggs clumped together, so that very few were hatched.

The development of the egg, as may be seen in Plate 1, figs. 3 to 11, is typical of that of any teleostean fish. Under ordinary room temperature of 27.5° C. it is relatively fast. The early cleavage stages are not illustrated, for they were not observed; they took place during the transport of the impregnated eggs from the fishing ground to the laboratory.

About twelve hours after impregnation the egg is in the primitive-streak stage. The primitive streak appears as a linear thickening along the anteroposterior axis of the embryonic shield. During this time the head and tail regions are not yet in full evidence.

About fifty-five hours after impregnation the embryo is already fully developed, with the lens and optic vesicles clearly visible. An enlarged oil globule is clearly discernible in the yolk sac.

On the third day, approximately sixty-two hours after impregnation, the young fry is liberated from the eggshell. It measures about 1.5 millimeters in length. It is highly transparent with a few scattered black chromatophores along the ventral fin fold. The head is large and the semiovoid yolk sac is yet discernible, ventral to the head region. Upon liberation the fry begins to swim actively in the hatching dish.

It may be mentioned that even the recently spawned eggs of dangit, collected on the bottom of the terminal pound during the spawning run, were found to hatch in petri dishes after two or three days. These eggs, which were undoubtedly naturally fertilized, could be easily brailed out from the bottom of the pound with a plankton net or a fine-meshed dip net. This

is of prime importance in rescue work for the eggs of dangit and in supplying a hatchery.

The newly hatched fish were transferred to glass jars of 3-liter capacity, which were previously provided with sand and aquatic plants (*Enhalus achoroides* Rich.). But because the fish were fast dying even before the resorption of the yolk, they were all preserved in 5 per cent formalin. The death of the embryos was probably due to lack of sufficient aëration and other factors which are still undetermined.

The use of the hatching box in Tagbilaran, Bohol, for the hatching of the eggs of dangit was quite successful, but very few fry were hatched from the eggs, possibly due to insufficient circulation of water in the hatching box and the clumping together of the eggs. In this hatching box the eggs began to hatch two to three days after impregnation. The newly hatched fry were immediately released in the nursery grounds.

SUMMARY AND RECOMMENDATION

1. The principal fishing as well as the spawning season for dangit in Murcielagos Bay and Bantayan, Bantayan Island, Cebu, is from January to April, inclusive, of each year. In Tagbilaran and vicinity, Bohol, the season falls in January and February.

2. The actual time of spawning varies in different places. It lasts from the fourth to the seventh night after the appearance of the new moon in Bantayan, Bantayan Island, Cebu, and from the fifth to the sixth night of the new moon in Murcielagos Bay and Tagbilaran, Bohol.

3. The dangit female is a very prolific fish, depositing from 300,000 to 400,000 eggs at one spawning.

4. The artificially impregnated eggs hatch in two to three days. The rescued eggs from the spawning ground hatch at the same time as those of the artificially fertilized eggs.

5. The adhesive property of the eggs of dangit appears to reduce the percentage of hatching both in the petri dishes or in the hatching box. This being one of the greatest drawbacks in the hatching of the eggs, it is recommended that starch, swamp muck, and other ingredients that would eliminate this adhesive property of the eggs, be tried in an organized hatchery.

6. Other types of hatching boxes that would provide better circulation of water should be experimented with.

7. It is recommended that further studies on the comparative efficacies of the wet and dry methods of impregnation be undertaken.

8. For the rehabilitation of the dangit fishery, a hatchery, preferably a floating one, should be constructed so that rescue work and artificial propagation of dangit and other important fishes may be undertaken.

ILLUSTRATION

[Drawings by Pio C. Medel.]

PLATE 1. DANGIT, *Amphacanthus oramin* (BLOCH AND SCHNEIDER)

FIG. 1. Unripe eggs, × 80.

2. Ripe eggs, × 70.
3. Unfertilized eggs, × 60.
4. An egg two and one-half hours after impregnation, × 60.
5. An egg five hours after impregnation, × 60.
6. An egg seven and one-half hours after impregnation (primitive-streak stage), × 60.
7. An egg nine hours after impregnation (germ-ring stage), × 60.
8. An egg twelve hours after impregnation (primitive-streak stage), × 60.
9. An egg fifty-five hours after impregnation, × 60.
10. A newly hatched fish, × 100.
11. Dangit sperms, highly magnified.

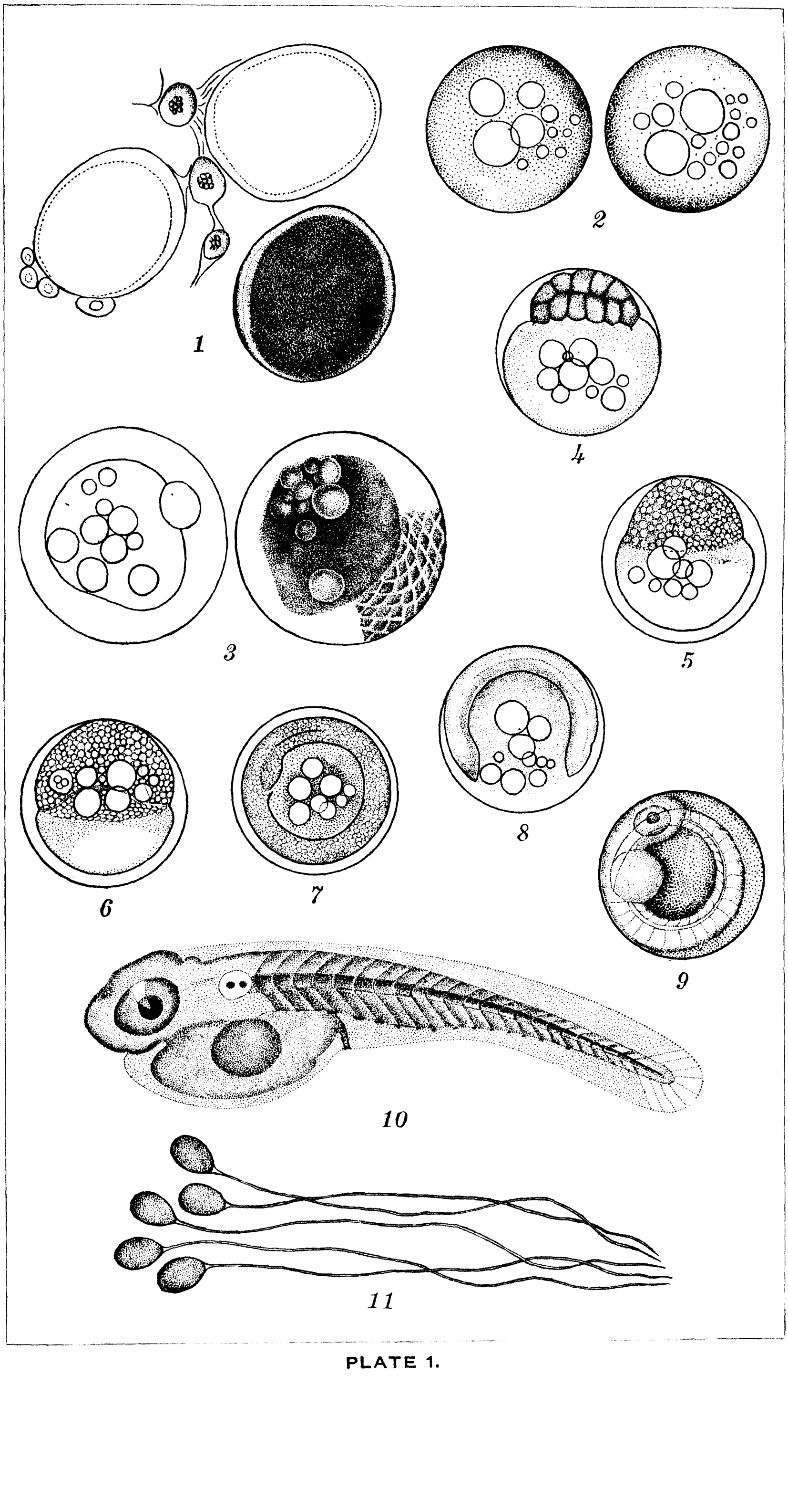

PLATE 1.

THE GEOLOGY OF PUERTO GALERA, MINDORO

By JUAN S. TEVES
Of the National Museum Division, Bureau of Science, Manila

THREE PLATES AND ONE TEXT FIGURE

INTRODUCTION

Mindoro has not been studied geologically as much as the other large islands of the Philippines, and the literature on the subject is very limited.

Becker [1] and Smith [2] merely mentioned a few rocks and minerals found on the island by foreign travelers and explorers during the Spanish régime. Merrill [3] and Mearns ascended Mount Halcon in 1906 and recognized the rocks on its summit. Dalburg [4] wrote a short paragraph on the geology of the low alluvial country in the San José Estate, southern Mindoro, and José Nieto y Aguilar [5] gave a brief description of some parts of the island, including Puerto Galera, which is the place treated in the present paper.

The writer visited Puerto Galera in 1933, when the President of the University of the Philippines requested the staff of the Department of Geology and Geography, of which the writer was a member, to make a geological study of it. Another visit was made in the summer of 1935 to complete the data, principally on its physiography, structural geology, and historical geology.

FIELD WORK

A reconnaissance survey was made in the summer of 1933, and a detailed study together with the revision of previous data was carried out in the summer of 1935. The investigation was done mostly along the shores, where excellent exposures of formations are found; some trips towards the interior were made,

[1] Becker, G. F., U. S. Geologic Surv. 21st Ann. Rep. 3 (1901) 18.

[2] Smith, W. D., Geology and Mineral Resources of the Philippine Islands, Manila (1924) 257.

[3] Merrill, E. D., Philip. Journ. Sci. § A 2 (1907) 201.

[4] Dalburg, F. A., Philip. Journ. Sci. § B 9 (1914) 143.

[5] Nieto Aguilar, J., reseña geográfico-geologico-minera de las mismas. Colonización de Filipinas—Madrid, Alonzo 12 (1893) 8, pt. 2 50–52.

especially along the rivers and creeks. The writer used as a base map United States Coast and Geodetic Survey chart No. 4344.

FIG. 1. Mindoro Island, showing the area studied (area in rectangle).

THE PHYSIOGRAPHIC FEATURES OF MINDORO [6]

Mindoro has an area of 9,826 square kilometers and is the seventh largest island in the Philippines. Its topography is characterized by two mountain clusters or masses, the Mount

[6] Faustino, L. A., The Mineral Resources of the Philippine Islands for the years 1924 and 1925 (1926) 33.

Halcon mass on the north and the Mount Baco mass on the south which are separated by a transverse valley. In some places, especially in the northern and western parts, the mountains are very close to the sea and interrupt the coastal plains, which are generally narrow. The greater expanses of these are found in the eastern and southern portions of the island.

The coast of the island is irregular; in some places it consists of coral reefs.

The important rivers are Baco, Baruyan, Calapan, Abra de Ilog, and Subaan on the north; Silonay, Sinabu, Navotas, Cavayan, Pola, Pinamalayan, and Aglubang in the east; Caguray and Bulalacao in the south; and Sinambolan, Batbuajan, Hangpong, and Arunay in the west.[7] The rivers radiate from the mountain masses into the sea.

Lake Naujan, in the northeastern part of the island, is the only lake of importance. It has an area of 70 square kilometers and is estimated to be 20 meters above sea level. Its greatest depth is 15 meters. It is believed to be of volcanic origin.[8]

BRIEF GEOGRAPHIC SKETCH OF PUERTO GALERA

LOCATION AND EXTENT

The area under discussion is about 30 square kilometers, and lies in the northern part of Mindoro between latitudes 13° 29′ and 13° 32′ north and between longitudes 120° 54′ and 121° 00′ east.

ACCESSIBILITY

Puerto Galera is accessible from Manila by either of two routes—(*a*) by railroad to Bauan or Batangas, in Batangas Province, and from there by sailboat; or (*b*) by boat from Manila to Calapan, Mindoro, and from there by motorboat. The first is an eleven to sixteen-hour trip, depending on the wind, and the second is about an eighteen-hour trip.

At present this municipality is isolated from the rest of the island by lack of roads, but there is a project to connect Abra de Ilog with Calapan through it. If this is done Puerto Galera will be more prosperous than it now is.

THE PHYSIOGRAPHY OF PUERTO GALERA

Although Puerto Galera is of small areal extent, its features are numerous and varied, due mostly to the lithologic diversity

[7] Census of the Philippine Islands: 1918 1 (1920) 187.
[8] Pratt, W. E., Philip. Journ. Sci. § A 11 (1916) 234.

of its rock formations, the fundamental geologic processes in operation, and its position with reference to the sea.

The region under consideration is located at the foothills of a cluster of mountains—the Baletero, the Malasembo, and the Talipan—which belong to the mountain mass of Mount Halcon. There are in places behind the coves low, flat-lying lands, semicircular in outline and with areas of less than a square kilometer. They are mostly the combined result of marine and stream gradation. One of them is the site of a former lake.

The most striking feature is a plateau, at about the end of the peninsula at Escarceo point. The plateau is almost completely surrounded by steep cliffs.

The approach to the mountain cluster referred to above is in its topographic youth. It is dissected by ravines with rapids and falls debouching on the sides of the bays and coves. At low tide the mouths are shut off from the sea by sand bars, formed by the action of waves and currents. There are no large rivers. The only rivers of importance are the Tabinay and the Lagundian.

Near the shore and on Medio and Boquete Islands,[9] and on Escarceo Peninsula,[10] the topography is rolling, the hills having an even elevation of about 80 meters.

There is no permanent lake in the locality. Mendez de Vigo is said to have found a small, very deep lake which had the smell of sulphur and was suspected of beng a crater,[11] but this lake cannot be found at present, nor do the inhabitants know of any lake, except a depression filled with water during the rainy season. This depression is behind Laguna Cove, and is believed by the writer to be the bottom of a dried lake. It is divided by a slight elevation, so that two lakes are formed when the level of the water is not high.

There are swamps south and southwest of the town, at the mouth of Tabinay River and in Sigayan Cove. The first two are nipa swamps, and the last is a mangrove swamp. None of them is extensive.

[9] The island marked Paniquian on U. S. Coast and Geodetic Survey map No. 4344 is known as "Boquete" to the people. They give the name "Paniquian" to a point in Medio Island which projects into the Manila or Northwest Channel.

[10] The peninsula is here called "Escarceo" from a point at its extreme end.

[11] Becker, G. F., U. S. Geologic Surv. 21st Ann. Rep. 3 (1901) 45.

At the Tabinay Na Malaki are two springs, one of which is thermal with a temperature of 33.3° C. A cool spring is reported at Baletero. Favorable artesian circulation is undoubtedly responsible for these, as they are found in limestone formations. The temperature of the warm spring may be attributed to contact with deep-seated igneous rocks still in the process of cooling.

There are two bays, Puerto Galera and Varadero, and numerous coves, which together with the islands and promontories make the coast line very irregular. Coral reefs, mostly fringing, abound along the shore with living specimens in the surrounding waters. Elevated beaches and wave-built terraces are very conspicuous in some of the coves.

The following are the important features in the physiography of Puerto Galera:

1. The absence of extensive plains. Narrow strips of coastal plain are wanting.
2. The plateau in Escarceo Peninsula.
3. Absence of large rivers. The streams usually debouch on the sides of the bays and coves. Their mouths are usually shut off from the sea by sand bars during low tide.
4. The rolling topography in Boquete and Medio Islands and in Escarceo Peninsula.
5. The general sameness of elevation of the hills in these places.
6. The presence of a dried lake, probably of volcanic origin.
7. The presence of swamps.
8. The presence of cool and thermal springs.
9. The presence of elevated beaches or wave-built terraces.
10. The irregularity of the coast line enhanced by coral reefs, mostly fringing.

RELATION OF TOPOGRAPHY TO STRUCTURE

The ruggedness and great relief adjoining the mountain cluster is due mainly to the attitude of the metamorphic rocks brought about by deformation—intrusions and extensive jointing. Partly responsible is also the presence of marble and limestone, which are weathered by rain water.

The points and projections of land into the sea usually terminate in serpentine rocks that are fairly resistant to erosion. They are lenticular intrusions from which the overlying for-

mations have been removed by denudation. Thus they form hills and contribute to the irregularity of the coast.

Calcareous and somewhat tuffaceous shales, sandstones, and limestones were subjected to gentle warping. Their attitude points to the existence of a dome fold that has been affected by faulting and erosion.

In some cases the slope of the land has the same direction as the inclination of the strata, although the first has always been found to have a greater angle. The steep cliffs represent fault scarps. The rolling topography is due to differential erosion.

GEOLOGIC FORMATIONS

IGNEOUS

On two occasions the writer encountered small outcrops of what he believes to be the basal rocks and, therefore, the oldest in the area under consideration. These consisted of coarsely crystalline granodiorite and granite (localities 7 and 51) with abundant quartz and feldspar. The granodiorite is flesh-colored in parts, and in other parts, white, due to quartz and decomposing feldspars. The granite is white and speckled with hornblende and mica.

Merrill says that Mount Halcon is a mass of granite, white quartz, schist, and marble,[12] although Smith claims to have identified some of these rocks as andesite.[13] Probably Smith found some andesite among the rocks collected by Merrill. If these findings are true, then Puerto Galera and Mount Halcon have the same formation and they may have also the same geologic history.

The granite in Mount Halcon may be the same as that found in Lubang Island by Elicaño.[14]

The writer suspects that the granodiorite and the granite that he found in Puerto Galera are contemporaneous with those found by Alvir in Bulacan Province and classified by him as early Palæozoic.[15]

THE METAMORPHIC ROCKS

Puerto Galera formation (schist and gneisses).—The metamorphic rocks are gneisses, schist, and marbles. The gneisses

[12] Merrill, E. D., Philip. Journ. Sci. § A 2 (1907) 256.

[13] Smith, W. D., Geology and Mineral Resources of the Philippine Islands, Manila (1924) 256.

[14] Op. cit. 259.

[15] Alvir, A. D., Philip. Journ. Sci. 40 (1929) 399.

possess both the banded and the lenticular texture. The gneisses and also the schists were metamorphosed from the granodiorite and granite. This is evidenced by the superposition of the schists and gneisses, and the fact that they contain muscovite, biotite, and feldspars. Their color is a light brownish gray. On the other hand, the carbonates associated with the schists and gneisses indicate their sedimentary origin. The metamorphics in this locality may therefore be of dual origin—igneous and sedimentary—the latter predominating over the former. Those of igneous origin are the granite gneisses and those of the sedimentary, marbles (impure limestones).

The schists are of two types. One of them liberates carbon dioxide when treated with hydrochloric acid, while the other does not have this reaction. The former, together with some specimens in which marbles are included between the folia, denotes either impurity of sediments at the time of metamorphism or deposition by percolating water. It is this fact that makes the writer believe that the majority of the schists, and, in fact, most of the metamorphics, are of sedimentary origin.

Some, however, are derived from serpentine and other secondary minerals, as chlorite and talc, which usually compose it.

The predominating schists are sericite, chlorite, and serpentine. They are green of varying shades. Phyllite encountered in the weathered condition is merely a phase of schist. It appears also to be of sedimentary origin.

Metamorphic rocks are also found in other localities of the Philippines, as in Ilocos Norte, Camarines Norte, Caramoan Peninsula, Cebu, Zamboanga, Surigao, Palawan, and Romblon;[16] but their age is uncertain. Masó and Smith believe them to be Tertiary.[17] Romblon[18] may be an exception because of the similarity of its rock formations and its proximity to Mindoro.

As no equivalent of this formation is known with certainty in the Philippines, the writer proposes to call the schists and gneisses the Puerto Galera formation, to conform with Alvir's Zamboanga formation in his table of Philippine Stratigraphy[19] and were it not for the fact that this term is not recognized,

[16] Smith, W. D., Philip. Journ. Sci. § A 5 (1910) 324.

[17] Masó and Smith, Philip. Journ. Sci. § A 8 (1913) 211.

[18] Adams, G. I., Philip. Journ. Sci. § A 4 (1909) 87.

[19] Alvir, A. D., Synopsis of Lectures in Physiography, Part II, table 3. Technology Coöperative Co., Manila (1928).

the same nomenclature could have been applied to avoid the naming of too many formations, which results in confusion in the established geologic column of the Philippines.

Romblon formation? (marbles).—This formation consists of fine-grained, compact rocks of varying colors—white to yellow-banded gray. The rocks are in massive blocks, possibly due to jointing, and are badly weathered. In this as in other regions, they are associated with the schists and gneisses and the same remarks can be made on them.

Cinco Pisos formation? (serpentines).—In some points along the coast serpentines can be seen. They are intrusions in the form of lenses into the metamorphic rocks. They have been laid bare by erosion, and are doubtless the same serpentines as those found by Elicaño in Lubang and Golo Islands.[20]

There is no way of estimating the thickness of these metamorphic-rock formations as they are badly contorted and jointed and are further complicated by erosion.

THE SEDIMENTARIES

The basal conglomerate.—This conglomerate is made up of particles or pebbles of quartz, marble, schists, and the serpentines described above. It is so indurated and compact that when hammered it does not break off between the pebbles as most conglomerates, but rather at its own fracture. This rock has a very limited distribution.

One specimen was encountered just below the shales at Boquete (locality 28) and another as a float in Minulu Point (locality 13). This limited distribution suggests its mode of occurrence, that is, in the form of lenses, otherwise the stratum could be traced for distances. It also indicates the conditions under which the formation of this conglomerate took place, a subject discussed below under geologic history.

Because of the position of this conglomerate with reference to the other rocks, and because of its physical character, the writer believes it to be old, possibly Eocene. It may be contemporaneous with the conglomerate that Smith describes to be of varying thickness and containing fragments of practically all the other rocks—diorite, andesite, schist, and slate. He places this at the base of the Tertiary.[21]

[20] Smith, W. D., Geology and Mineral Resources of the Philippine Islands. Manila (1924) 259.

[21] Op. cit. 76.

Alpaco formation? (shales and sandstones.)—The shales are tuffaceous and marly. Some possess the grayish color of volcanic tuffs, and may easily be mistaken for these. Others range from buff to yellow. They are fine-grained and stratified. The buff and yellow strata that are usually found on the higher portions of the formations are sometimes interstratified with a brownish red, coarser material that is more resistant. On the lower portions the shale is interstratified with fine-grained sandstone. The probable thickness of this formation is about 290 meters. These shales are mostly confined to Boquete and Medio Islands and Escarceo Peninsula, where they lie unconformably on the metamorphics.

Limestones.—The limestones are coralline and fossiliferous. The fossils found in them can still be found as living species. In fact these formations are continuous with living coral reefs found in the waters of the locality. Among the fossils are pecten, oysters, and various kinds of colonial and individual corals broken in small pieces and cemented together.

This formation is stratified in places and in others it is massive. The beds are about one hundred meters thick and lie unconformably on the shales. At the base of some of the limestone cliffs can be found conglomerates made up mostly of the shells of marine invertebrates. These conglomerates are of the same age as the limestone formation.

Alluvial and other recent deposits.—These deposits are best developed at the depressions behind the coves or bays. They consist of soils derived from the surrounding rocks, mostly metamorphics near the mountain mass, and shales and limestones on the islands and the peninsula. Along the shores are found quartz sands and gravels or limestone sands and gravels, depending on the parent rock. There are also places along the coast, as along Tabinay, where the broken, rather flat pebbles of schists are found. These pebbles have assumed oval or elliptical shapes due to wave action. Lacustrine deposits are encountered where the lake mentioned above existed.

GEOLOGIC STRUCTURE

As previously noted, this area is located at the foothills of one of the mountain clusters or masses (Mount Halcon cluster) of the island. The metamorphic rocks overlie the granite and granodiorite. The former is slightly arched and broken, due probably to later intrusions of basic igneous rocks. In some

cases these are lenticular and have been altered into serpentines. Some exposures of the metamorphic rocks show contortions.

Elicaño [22] stated with regard to the relation of the rock formations in Lubang Island:

> From the data in hand it seems that the serpentine constitutes the basal formation over which the metamorphosed sedimentaries were laid during the period of submergence of the former. Probably contemporaneous with the formation of the coral beds or preceding it, the intrusion of the granite metamorphosed the sediments into their schistose forms, and the subsequent elevation of the region brought up the coralline formation to the present state.

With this view the present writer is unable to agree, largely because of the fact that these rocks show very extensively the effect of dynamic metamorphism.

The shales are the next formation of importance in the structure of the region, the basal conglomerates mentioned in a previous paragraph being found only in lenticular patches. These do not seem to have suffered great deformation.

As can be seen in the accompanying sections, the shales are unconformable on the underlying metamorphics and on the overlying limestones. The limestones were in some cases subjected to the same agents as the shales, and therefore show almost the same attitude. In most cases, however, they occur in massive forms that have never been disturbed.

The faults are minor and local in character and cannot be traced to any major fault, but they may be the effect of a great fault or faults.

GEOLOGIC HISTORY

PALÆOZOIC HISTORY

Before the Permian period, when this region was still under water, there were local intrusions of granite and allied rocks and small amount of granodiorite in the Philippines. Mindoro, at least the part where Puerto Galera is located, must be one of the sites of these intrusions. Lubang Island, which is not far from Mindoro, has some granite and must have similar intrusions. The granite and granodiorite found in the area studied must belong to the same age as that of Lubang, because of their proximity and their similarity.

In the later part of the Palæozoic, during the Permian revolution, the depression of the China Sea occurred, and contem-

[22] Smith, W. D., Op. cit. 259.

poraneous with it the intrusions of basic igneous rocks which form the skeletal framework of the Archipelago. These marked the position of the islands and formed the major tectonic axes.

MESOZOIC HISTORY

The Mesozoic history of the Philippines is somewhat obscure, especially when dealing with the metamorphic rocks, as their relation with other rock formations has not been definitely established.

The ultra basic intrusions throughout the Philippines, which are recognized in Puerto Galera in the altered form, the serpentines, belong to the Cretaceous. They are found intruded into the Triassic schist and gneisses.

Fine sediments were being deposited at the beginning of the Mesozoic. In the later part of the Triassic these, together with the rocks on which they rested, were metamorphosed. This process simply represents another revolution, although perhaps very much less than the preceding Permian revolution. Localities other than Mindoro were undoubtedly affected by it.

The Jurassic, which is very limited in distribution, and the Comanchean, a probable missing chapter in the Philippine Mesozoic, were not encountered or recognized in the field so that the Cretaceous naturally follows.

This last period of the Mesozoic in the Philippines was characterized by the ultrabasic intrusions, and in Puerto Galera these are represented by serpentines, the altered products of such rocks. There must have been an uplift contemporaneous with these intrusions or possibly inaugurating the opening of the next period.

TERTIARY AND POSTTERTIARY HISTORY

At the beginning of the Cenozoic the topography of Puerto Galera must have had characteristics similar to that of today as the conglomerate is discontinuous. It was either formed in an irregular coast line with inclosed bodies of water, or erosion must have been great at the time it was brought above water.

This part of Mindoro must not have been affected by other events taking place in the Philippines in the following periods, the formations of which are not represented. This region must have maintained its position above water continually up to the close of the Miocene. This hypothesis is in perfect agreement with the fact that the removal of the great thickness of meta-

morphic rocks necessary to give the place its present surface configuration would involve a long time.

At the close of the Miocene the area submerged very slowly, giving time for the formation of shale deposits. At times during the succeeding period volcanic explosions must have taken place not far from this neighborhood, as the shales are tuffaceous. Then this region emerged at about the end of the Pliocene, only to be under water in the Pleistocene, when the coral reefs were forming.

These coral formations and the shales were only slightly affected by diastrophic movements at the time, and a slow but continuous uplift, amounting to a little more than one hundred meters, took place up to the present.

ECONOMIC GEOLOGY

While there are plenty of minerals in the area, it can generally be stated that they do not exist in sufficient amounts to warrant their exploitation.

The marble appears to be of good quality, but as it is badly broken and weathered, it is not worth quarrying. Romblon, which is near Mindoro, has been worked, so that those interested in marble can look to this island for their supply.

Magnesites are found in veins in serpentine rocks. A very small deposit of limonite was seen in the same rock. An incomplete gradation into chromite was also encountered. Gold is reported to have been found in the sands of Tabinay River.

With the exception of this last metal, the working out of these minerals seems to be a losing undertaking, at least until more intensive prospecting has been done.

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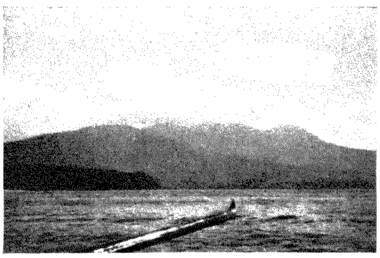
ILLUSTRATIONS

1



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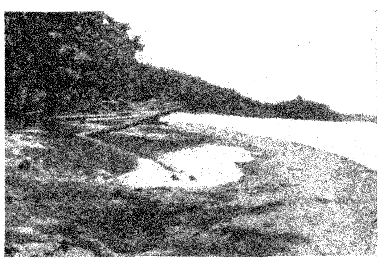

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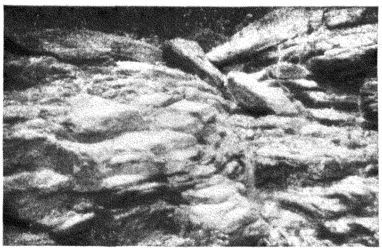
PLATE 1.



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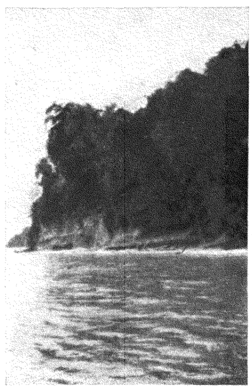

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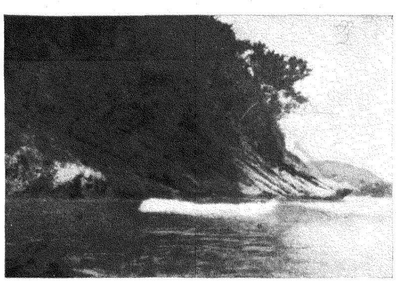

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PLATE 2.

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NEUROPTEROID INSECTS FROM FORMOSA

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THREE PLATES

In 1934 Mr. J. Linsley Gressitt collected a fair number of neuropteroid insects on Formosa. Dr. R. Takahashi has sent me for study his collection of Formosan Psocidæ. These collections form the basis of the following account.

Few collections of these insects have been made on the island. Over twenty years ago Sauter collected insects in the southern part of the island. His material in this group was reported upon by Klapalek, Enderlein, and Petersen. Okamoto and Nakahara have described several species in their papers on these insects of the Japanese Empire. Later Issiki published a large paper on the Panorpidæ.

It is at once noticeable that with these insects, as with others, the island shows great affinity to the Asiatic mainland, particularly the highlands. There are, it is true, a few species widely spread in the Malay region and even to the Philippines, but, as a rule, the species and many genera are different from those of the Philippines. The numerous Panorpidæ, the large sialids, and the *Raphidia* species, as well as the bulk of the Perlidæ, are entirely foreign to the Philippines.

To Japan proper there is much more affinity, although the island is three times as far from Japan as it is from the Philippines. Most of the genera and a number of the species are the same as those of Japan, fully as great a proportion as in adjacent China.

I have included a few species taken in the Loochoo Islands, northeast of Formosa.

A set of the Psocidæ has been returned to Dr. R. Takahashi; the rest of the material is in the Museum of Comparative Zoölogy.

PSOCIDÆ

Genus ISOPHANES novum

Wings of the texture and appearance of *Calopsocus*, being concave and the tip bent down; the surface of the forewing is roughened in only a few places and then less strongly than in *Calopsocus*. The forewing has the long discoidal cell as in that genus, but the cubitus has not the long fork and there is no trace of the irregular venation characteristic of *Calopsocus*. There are but three branches of medius beyond the cell (four in *Psocus*); the stigma is like some species of *Psocus*, strongly angulate behind, and in one species (*P. palliatus* Hagen) there is a very distinct process to the angle; in the hind wing the medius is not forked.

Type of the genus, *I. decipiens* sp. nov.

I include also *Psocus palliatus* Hagen. The genus is an offshoot of *Calopsocus*, differing principally in the more regular venation.

ISOPHANES DECIPIENS sp. nov.

Head reddish, labrum brown, nasus darkened, as also the vertex, in alcohol the head is pale yellow; vertex almost as sharp as in *Calopsocus*, distinctly bilobed; antennæ pale on base, black beyond (in alcohol pale), moderately hairy. Thorax above yellowish, pleura darkened; legs pale, tips of tibiæ and tarsi dark, hind femora dark, abdomen pale. Head structure as in *Calopsocus infelix*. Forewing with short hairs on veins as in *Calopsocus*, those on basal costal edge also short. Membrane fairly shining and wholly dark brown; hind wing fumose, with darker veins.

Venation as figured, discal cell long, no fork to cubitus, no trace of irregular venation, stigma strongly angulate behind, but no process. Condition of medius and radial sector at the connection variable, sometimes just touching at one point, sometimes united for a very short distance, and in one specimen with a very short crossvein.

Length, 4 to 4.5 mm.

FORMOSA, Hassenzan, June 26; Sakahen, July 13; Bukai, June 13 and 14; Urai, May 1 (*Gressitt*); Taihoku, May 14 (*Takahashi*). Type, M. C. Z. No. 21757; paratype in Takahashi collection.

Isophanes palliatus Hagen (*Psocus*) is a smaller species, with darker head and thorax and pale antennæ, the stigma has a very distinct process from the angle behind.

PSOCUS TOKYOENSIS Enderlein.

FORMOSA, Rokki, May 13 to 26; Chipon, April 18; Musha, May 20; Taihoku, May 22 and July 17; Hassenzan, June 23 to 27; Kuraru, April 11, May 4, and June 3 to 9. LOOCHOO ISLANDS, Iriomote Island, July 1 (*Gressitt and Takahashi*).

Psocus capitatus Okam. is but a variation of this species.

PSOCUS FORMUSANUS Okamoto.

FORMOSA, Kuraru, June 3 to 9; Hori, July 5 to 9; Masha, May 20; Hassenzan, June 27 (*Gressitt*).

PSOCUS SEXPUNCTATUS Linnæus.

FORMOSA, Hori, July 5 to 9; Musha, May 21; Suisha, June 1 (*Gressitt*).

PSOCUS FILICORNIS Enderlein.

I identify four females from Rokki, May 13 to 26; Kuraru, May 7; Kanshrei, April 18; and Arisan, July 5 (*Gressitt and Takahashi*), as probably this species described from Singapore and based on males. These specimens are closely related to *P. longicornis;* one specimen has about the basal one-tenth of wing black, the others scarcely show it (in males the basal fifth is black); otherwise the wing is clear except the black stigma. In all four the areola postica is very narrow above, almost pointed; Enderlein does not mention this; the European *P. longicornis* has a broad top to areola postica.

PSOCUS OBSITUS Enderlein.

Hassenzan, June 26; Hori, July 8 and 9 (*Gressitt*).

PSOCUS SAUTERI Enderlein.

Hassenzan, June 22 to 27; Bukai, June 14 (*Gressitt*).

AMPHIGERONTIA JEZOENSIS Okamoto.

FORMOSA, Kanshrei, April 19. LOOCHOO ISLANDS, Iriomote Island, July 1 (*Gressitt and Takahashi*).

SIGMATONEURA SINGULARIS Okamoto.

Kuraru, June 3 to 9; Shonoryo, June 11; Shirin, October 11 (*Gressitt and Takahashi*).

COPOSTIGMA HYALINA Okamoto.

Kuraru, May 5 (*Gressitt*).

TÆNIOSTIGMA INGENS Enderlein.

FORMOSA, Hassenzan, June 23 to 27; Arisan, July 5; Kanshrei, April 18; Kuraru, June 3 to 9; Suisha, June 2; Shonoryo, June 11; Taihoku, June 29. CHINA, Foochow, August 3 (*Gressitt and Takahashi*).

KODEMAIUS BREVICORNIS Okamoto.

Taihoku, March 27 to April 25; Taiheizan, May 8; Kuraru, May 5; Mareppa, August 10; Hassenzan, June 27 (*Gressitt and Takahashi*).

The female is much larger and darker than the male, with eyes wide apart, but still very prominent.

LOPHOPTERYGELLA CAMELINA Enderlein.

Taihoku, May 22 and July 18; Kagi, April 24; Keelung, July 31 (*Takahashi*).

Genus STENOPSOCUS Hagen

Of the four species of this genus, one agrees with the common Japanese form and the others are new with a more angulate stigma than that in the Japanese species. The venation is about the same, with frequent variations in length of forks, and in one case with an extra fork to the radial sector.

Key to the species of Stenopsocus.

1. Head pale, with a median black stripe from vertex through ocelli and over nasus, clypeus somewhat darkened, femora yellowish, in males the tibia nearly black, stigma slender, dark behind, not as wide as length of the crossvein; basal joint of antennæ pale........ *aphidiformis*.
   Head largely black, with more or less evident pale spot in middle of vertex; clypeus pale .... 2.
2. Pterostigma yellow, bordered with black only on the outer part of hind margin, legs wholly pale; basal joint of antennæ partly pale. *externus*.
   Pterostigma marked with dark all along the hind margin; basal joint of antennæ black .... 3.
3. Hind tibiæ black in both sexes; stigma plainly angulate behind; thorax scarcely pale in the middle.................................... *tibialis*.
   Hind tibiæ pale (as rest of legs); stigma but little angulate behind; thorax pale in middle.................................... *formosanus*.

STENOPSOCUS APHIDIFORMIS Enderlein.

Bukai, June 13 and 14; Rokki, May 13 to 26; Hassenzan, June 22 to 27; Musha, May 20 and 21; Arisan, June 6 and 7; Sakahen, June 16 (*Gressitt*).

STENOPSOCUS FORMOSANUS sp. nov.

Head black, shining, a large transverse yellowish or whitish spot on vertex, clypeus very pale; antennæ wholly black; thoracic notum black, with a pale median stripe between black lateral lobes; pleura black; abdomen dark on base, beyond pale as also venter, tip black; legs pale, knees darker as also tips of hind tibiæ and tips of all tarsi. Wings hyaline, venation brownish, radius brown to deep black, in several females a large, elongate, dark spot over origin of radial sector; stigma yellow, its hind margin bordered with black along entire length and extending down on crossvein, stigma here scarcely as wide as length of crossvein, and crossvein about as near to tip as to base and scarcely oblique; angulation of stigma fairly prominent.

Length to tip of wing, 5.5 to 6 mm.

FORMOSA, Hassenzan, June 22, 25, and 26; Arisan, May 27 and June 6 (*Gressitt*). Type, M. C. Z. No. 21760.

STENOPSOCUS TIBIALIS sp. nov.

Head black, clypeus very pale, pale median spot on vertex not so very distinct; antennæ wholly deep black; thoracic notum black; a median rather yellowish area, pleura black; abdomen dark at tip; legs largely pale, but hind tibiæ wholly black. Wings hyaline, veins rather pale, radius brown, sometimes slightly margined; stigma yellow, its posterior margin bordered with deep brown and extending down on crossvein, stigma plainly angulate at crossvein and here as broad as length of crossvein, crossvein at about middle of length and slightly oblique.

Length to tip of wing, 5.5 to 6 mm.

FORMOSA, Arisan, May 24 and 29; June 2 and 7; Taiheizan, May 8 (*Gressitt*); Arizan, April 22 (*Takahashi*). Type, M. C. Z. No. 21759; paratype in Takahashi collection.

STENOPSOCUS EXTERNUS sp. nov.

Head black, shining, a large transverse pale spot on vertex, clypeus pale; antennæ deep black, basal joint partly pale, especially below, thorax black, a small, faint, pale, median area; pleura mostly dark; abdomen pale, dark at tip; legs pale, tips of tarsi darker. Wings hyaline, veins pale, radius brownish; stigma clear yellow, its posterior external edge broadly bordered with deep black as far as crossvein; stigma angulate behind at crossvein and here plainly broader than the length of the crossvein, this crossvein nearer to base of stigma than to apex, and scarcely oblique.

Length to tip of wings, 5 mm.

FORMOSA, Taihoku, May 5; Arisan, May 29 (*Gressitt*) and April 19 (*Takahashi*). Type, M. C. Z. No. 21758; paratype in Takahashi collection.

MATSUMURAIELLA ENDERLEINI sp. nov.

This is very close to *M. radiopicta* Endl. and perhaps is but a subspecies or race of it.

Both of my Japanese specimens agree with Enderlein's figure in having the branches of the radial sector widely divergent at the tips, so that the space is wider than that from the first branch to the stigma or from the second branch to the medius. In the four Formosa specimens the branches of the radial sector are much more parallel, so that the space between them at the tip is hardly as wide as that from the first branch to the stigma or from the second to the medius; in fact the radial sector and the medius lie rather nearer together, in one wing the lower branch of the radial sector touching the medius.

The principal difference, however, is that the hair on the head and thorax is about twice as long as in the Japanese specimens, and very dense, white on the head, black on the thorax; the wings are also more hairy and with longer hairs on the base.

The venation in both forms is variable as to the areola postica; in one Japanese specimen it just fails to reach the medius, and in some Formosa specimens barely reaches it; in none is it as long as in Enderlein's figure.

Length of forewing, 4.5 to 5 mm.

FORMOSA, Hori, May 25; Taiheizan, July 3; Arisan, June 4; Hassenzan, June 26 (*Gressitt*); Taichu, April 18 (*Takahashi*). Type, M. C. Z. No. 21756; paratype in Takahashi collection.

HEMIPSOCUS CHLOROTICUS Hagen.

Taihoku, June 4 (*Takahashi*).

AMPHIPSOCUS FORMOSANUS Okamoto.

FORMOSA, Chirifu, May 18; Sakahen, June 16 and July 13; Bukai, June 11 to 14; Hassenzan, June 22 to 27; Arisan, May 23 and 26; Suisha, June 2; Taiheizan, July 7 (*Gressitt*). CHINA, Foochow, August 3 (*Gressitt*). Very common. The male has the stigma almost wholly bright reddish, and a dark band from eye to eye. In two males from Arisan the areola postica is longer than high; in one wing of one specimen it is connected by a crossvein to the medius.

DYPSOCUS TAPPANENSIS Okamoto.

Urai, April 2; Shinten, April 2; Hakumo, November 1; Suisha, May 31 and June 1; Hassenzan, June 20 to 27 (*Gressitt and Takahashi*).

KOLBEA SERIALIS sp. nov.

Head pale, mottled with brown, five oblique brown lines each side between antennæ, ocelli on black spots, a brown spot in middle of the vertex and several smaller brown spots on each side; some erect long hairs on vertex; antennæ pale, slightly marked with brown, with rather sparse but very long hair.

Thorax dark, with small pale spots and lines; abdomen dark at base and at tip; legs pale, tibiæ with two dark bands.

Forewings hyaline, radius, medius, cubitus, and second anal to about middle of wing pale with dark spots, other veins dark; a dark spot at tip of each outer vein, base and apex as well as hind margin of stigma broadly dark, white in the middle, a faint dark cloud behind angle of stigma, and also in fork of radial sector and medius; a series of seven small brown spots subapically, one in each of the apical cells to and including the areola postica; hind wings pale, veins brown.

Stigma very large and strongly angulate behind, areola postica also very large, but a little longer than high.

Length, 3 mm.

FORMOSA, Chirifu, May 19 (*Gressitt*). Type, M. C. Z. No. 21762.

KOLBEA FUSCONERVOSA Enderlein.

Hassenzan, June 21 to 27; Musha, May 21; Hori, June 8 and 19; Sakahen, June 16 and July 13.

Enderlein says thorax "rostgelb," Okamoto, "rostgelblich." I have one discolored specimen which is so, but all the many others have three large black spots on the thorax; the one on anterior lobe is often divided by a narrow pale line; the principal veins are dark, sometimes very dark.

CÆCILIUS ARIDUS Hagen.

Taihoku, December 15, on bamboo; Suisha, June 2; Karenko, August 22; Arisan, May 24; Hassenzan, June 22 to 27.

CÆCILIUS PODACROMELAS Enderlein.

Taiheizan, May 8; Shikayan, May 12; Pianan, May 11; Arisan, May 24 and July 5; Taihoku, April 23 (*Gressitt and Takahashi*).

In one specimen one wing has a crossvein from areola postica to the medius.

CÆCILIUS OKAMOTOI nom. nov.

This is the *C. annulicornis* of Okamoto, which is preoccupied by Enderlein's name.

Riran, April 19 (*Gressitt*).

CÆCILIUS STIGMATUS Okamoto.

Bukai, June 13 and 14; Arisan, May 29, June 4 to 7; Hassenzan, June 22 to 27 (*Gressitt*). This small, dark-winged species has a pale area behind stigma, a white spot at base of areola postica, a white dot at nodus, and a whitish patch at base of stigma.

CÆCILIUS JAPANUS Enderlein.

Taiheizan, May 7; Kuraru, April 7; Bukai, June 13 and 14; Taihoku, December 18 (*Gressitt and Takahashi*).

CÆCILIUS FLAVIDORSALIS Okamoto.

Toran, May 23; Shinten, April 13 (*Gressitt and Takahashi*).

CÆCILIUS GONOSTIGMA Enderlein.

Urai, May 1; Taihoku, March (*Gressitt and Takahashi*).

CÆCILIUS FRATERNUS sp. nov.

Head yellowish brown, nasus and labrum dark, both rather brassy, clothed with erect pale hairs; palpi and antennæ pale, latter with only moderately long hairs; thorax black, with short erect hair; abdomen pale brown, darker at tip; legs pale, unmarked. Forewing almost wholly brown, markings very similar to those of the figure of *C. himalayanus* Endl. Base of areola postica pale as in that species, very dark oblique mark on stigma reaching back, clear space behind stigma including the outer radial cell; wing darkest near middle of costal area and along outer margin as in *C. himalayanus*, but it differs in that the entire basal part of the stigma is snow white; the venation is the same, except that the cubitus is plainly a little sinous. The stigma is angulate behind. Hind wings very faintly infuscate, tips scarcely darker.

Length, 4 mm.

FORMOSA, Hori, July 5 to 9 (*Gressitt*). Type, M. C. Z. No. 21767.

CÆCILIUS MUGGENBURGI Enderlein.

Kuraru, May 5, June 3 to 9; Arisan, May 26; Taiheizan, July 7; Hassenzan, June 22. A widely distributed species.

CÆCILIUS DOLOBRATUS Hagen.

FORMOSA, Hori, June 9; Musha, May 20; Taihoku, March 14. LOOCHOO ISLANDS, Iriomote Island, July 19 and 25 (*Gressitt and Takahashi*).

Described by Hagen from Ceylon, also occurs in Singapore. Of the form of *C. muggenburgi*, it has two dark lines extending in front of the dark streak; one of these crosses the yellow stigma, the other borders the upper branch of the radial sector; the dark streak on outer part of wing reaches to the hind border; in middle of hind margin a wide hyaline area, but the base is largely dark; the hind wing is fumose except the outer costal part which is hyaline. The stigma is elongate, more swollen behind than in *muggenburgi*, but not angulate, the areola postica is short and quite high, larger than in *muggenburgi*. Enderlein puts it in a new genus, *Coryphosmila*.

CÆCILIUS CONFUSUS sp. nov.

Head and thorax largely deep jet black; antennæ pale on base, beyond black; abdomen brownish; legs very pale, almost white, very slender. Forewings hyaline, with a brown streak through to tip, at tip breaking up into three parts, one along each branch of radial sector, and a broader one over medius and its upper branch; hinder half of median cells clear to base of areola postica, from here the brown connects to the middle streak; basally the brown not as dark; cubitus and radial sector darkest; upper branch of radial sector curves up more than in allied forms, becoming almost transverse; stigma scarcely yellowish, moderately swollen behind, more so than in *C. muggenburgi*, but not at all angulate behind; space between medius and radial sector about as wide as in *C. muggenburgi;* areola postica larger than in that species. Hind wings fumose, with the outer costal area clear as in *C. dolobratus*.

Length, 4 mm.

FORMOSA, Arisan, May 24 and June 4 (*Gressitt*). Type, M. C. Z. No. 21768.

Differs from *tenuicornis* Karny in having radial sector and medius united for a longer distance and in lower areola postica.

CÆCILIUS SIMILARIS sp. nov.

Resembles *C. dolobratus* and *C. muggenburgi* in having a dark streak through middle of wing. It differs from *muggenburgi* in having a stigma angularly widened behind and with a dark spot to the streak, and first the branch of the radial sector bordered with dark, the outer hind border of the stigma is

sometimes dark. The dark streak is not straight, but in basal half of wing is nearer to costa, and at the connections it bends down and runs out to the tip of the wing from the median vein up to above the radial sector, leaving the apical part of the outer radial cell clear; all the space behind medius is likewise clear, and the medial cell is mostly clear or nearly so, but the cubitus and the base of the radial sector are black-bordered.

Hind wings with surface fumose, except outer costal area, just as in *dolobratus*. First branch of radial sector very oblique and parallel to outer border of stigma. Areola postica (which is clear) of moderate size, plainly longer than high, but reaching more than one-half way to medius. Medius and radial sector, when separating, leave a very broad space, especially near base, very much broader than in *dolobratus*, in which these two veins are rather close together.

Length, 4.5 mm.

FORMOSA, Arisan, May 24 and June 7; Taiheizan, July 7 (*Gressitt*). Type, M. C. Z. No. 21769.

This species is near to the European *C. fuscopterus*, but in that species the dark streak extends farther behind and occupies all of discoidal cell and most of the basal part of wing; the mark at the angle of the stigma is not so dark, and the medius and the radial sector lie closer together than in that species.

These four allied species of *Cæcilius*, each with a longitudinal dark stripe through the wing, can be tabulated as follows:

Key to four species of Cæcilius.

1. Median cells practically entirely dark; a dark mark from the dark streak up across the yellow stigma, latter swollen but hardly angulate behind; first branch of radial sector bordered with dark.... *dolobratus*.
   Outer median cells largely clear; no dark mark reaching across stigma. 2.
2. First branch of radial sector not bordered, no mark from dark streak towards stigma, latter elongate and very low, scarcely swollen behind. *muggenburgi*.
   First branch of radial sector bordered with dark.......... 3.
3. Stigma angulate behind, with a very dark spot from the angle to the streak; first branch of radial sector very oblique.......... *similaris*.
   Stigma rounded behind; no spot from stigma to streak, first branch of radial sector bending up so as to be more transverse, both branches bordered with dark .... *confusus*.

OPHIDOPELMA ORNATIPENNE Enderlein.

Hassenzan, June 22 to 27; Taihoku, April 28 (*Gressitt and Takahashi*).

MESOCÆCILIUS QUADRIMACULATUS Okamoto.

Suisha, June 2 and 11; Taiheizan, May 21 (*Gressitt and Takahashi*). One of the most beautiful species of Psocidæ.

HEMICÆCILIUS LIMBATUS Enderlein.

Hassenzan, June 22 to 27; Taihoku, January 18 (*Gressitt and Takahashi*). In one specimen the hind wing shows a faint infuscation near the tip and between the forks. Enderlein puts this species in his genus *Mepleres*.

HEMICÆCILIUS TRANSVERSUS sp. nov.

Head dull yellowish, no definite marks, labrum dark, face with fine white hairs, vertex with long erect bristles; antennæ with scattered long hairs; thorax more brown than head, abdomen also; legs pale. Forewings much marked with brown; a broad crossband covering stigma and areola postica, a large elongate mark over outer half of anal vein, continued basally, a mark in the cell before it, two large spots in area before radial sector, one beyond the sector and before the transverse band, this narrowly connected to spots behind it in the next two cells, apical margin narrowly dark; many of the veins in the pale areas narrowly bordered with brown; hind wings unmarked, veins brown. Stigma elongate and low, wholly rounded behind; areola postica moderately long, above reaching about halfway to the medius; apical forks short and subequal.

Length, 3 mm.

FORMOSA, Taihoku, December 18 (*Takahashi*). Type, M. C. Z. No. 21761; paratype in Takahashi collection.

Differs from *H. nigroguttatus* Karny in broader forewing, areola postica higher, radial sector and medius united for much greater distance diverging more at separation.

HAGENIELLA FORMOSANA sp. nov.

Head pale, a transverse brown mark on middle of vertex, often a dark mark each side by eyes, and one in front near the ocelli; head with scattered, long, erect hairs; antennæ pale, basal joint with a dark mark, clothed with quite long, sparse hairs; thoracic notum dark brown, a pale mark each side from base of wing forward, and faint lines between the lobes, upper pleura dark; abdomen pale, legs whitish. Forewings hyaline, costal veins pale, others mostly brown, especially beyond middle of wings; base of radial sector and medius before it joining radial sector plainly margined with brown; stigma white, brown at base and more broadly so near tip; extreme tip pale, a faint brown band

across areola postica, one before end of cubitus, and another basad of ends of anals; hind wings hyaline, veins mostly pale, but base of radial sector and cubitus dark.

In some specimens the radial sector and medius join for a short distance, in others just touch, and in one are connected by a minute crossvein.

Length, 2.5 to 3 mm.

FORMOSA, Taihoku, March, June 7, December 6 and 16; Rokki, May 13 to 26; Urai, May 2; Arisan, May 24; Kuraru, June 5 (*Takahashi and Gressitt*). Type, M. C. Z. No. 21770.

EPIPSOCUS HAGENI sp. nov.

Head whitish, three pale brown spots over ocelli, sometimes a faint brown mark at edge of vertex, back of eye; antennæ pale, basal joint with black dot outside, and the second joint with a black line; thorax pale; abdomen also very pale, with scattered black patches on each side, most numerous near base; legs very pale, tips of tibiæ and tarsi black; legs very long and slender.

Wings hyaline, veins also, but extreme tips of outer veins with a small but distinct brown mark; stigma whitish, no trace of any other marks; hind wing also hyaline and with pale veins, except two at tip are brown.

Venation similar to *E. delicatus* Hagen, and to *E. marginatus* Endl.; but areola postica more elongate and lower than in *marginatus*, stigma also slenderer than in *marginatus*. From *E. delicatus* the venation differs chiefly in that the space between radial sector and medius is much broader close to base, in *delicatus* it widens beyond base.

Length, 5 mm.

Rarasan, July 23; Hori, June 8; Rimogan, July 24; Rokki, May 13 to 26 (*Gressitt*); Shinten, April 3 (*Takahashi*). Type, M. C. Z. No. 21766; paratype in Takahashi's collection.

In *E. delicatus* Hagen (*completus* Banks) the forewings have a brown band near the outer margin and spots at the ends of the stigma as in *E. marginatus;* there is also a faint or distinct brown band running obliquely back from the basal end of the stigma, often meeting the end of the outer band, and towards the basal third of wing a transverse band. The areola postica in *delicatus* is slender as in *hageni*, much more so than in *marginatus*.

Epipsocus nubilipennis Karny, from Borneo, is practically the same as *delicatus*, but with the marks more extended. In a series from Mount Apo there are some strongly marked, others

only faintly so, but none as broadly marked as *nubilipennis*. *Epipsocus fuscofaciatus* Endl. is *Hageniella zonata* Hagen; Hagen's specimens vary in the connection between radial sector and medius.

ECTOPSOCUS CRYPTOMERIÆ Enderlein.

Taihoku, January 15, May 2, October 5; Hori, July 5 to 9 (*Gressitt and Takahashi*).

PERIPSOCUS QUERCICOLA Enderlein.

Kuraru, April 7, June 3 to 9; Urai, April 1; Sakahen, July 15; Taihoku, April 25 (*Gressitt and Takahashi*).

PERIPSOCUS SINGULARIS sp. nov.

Head red-brown, labrum black, rather densely clothed with short hairs, on basal part hardly longer than width of joint. Thorax black, clothed with appressed, short white hair, a pale stripe from base of wing obliquely forward, pleura mostly dark; abdomen brown, paler beneath; legs pale, tibiæ rather more brownish. Forewings uniform, pale, dull, dirty yellowish brown, veins mostly darker, especially cubitus which is heavier than usual, stigma about like veins; anal margin with many very short hairs; hind wings somewhat paler, veins mostly brown, cubitus also very distinct here.

Forewings with stigma quite long, not prominent behind, only gently rounded, and appearing much as in some species of *Cæcilius*.

Length, 4 mm.

FORMOSA, Taiheizan, May 21 (*Gressitt*). Type, M. C. Z. No. 21765.

This species has a stigma much like that of *P. sidneyensis*, of Australia; it is larger, with slenderer wings, and of a more yellowish tinge.

PARAMPHIENTOMUM NIGRICEPS sp. nov.

Nasus and front black up to above middle of eyes, across vertex a broad yellowish white band, faintly divided in the middle; cheeks pale; labrum and palpi pale, no distinct spines on palpi; ocelli in a low triangle, anterior one small, posterior nearly twice as far from eyes as from each other; dark parts with very minute white hairs; antennæ pale on base, brown beyond, moderately hairy, hairs about three to four times the width of joint; thorax brown, with white hairs, abdomen brown. Femora large, mostly dark, tibiæ with a dark band near base and another just beyond middle, basitarsus dark at base, tibia with many

spines, not as stout as in *Stimulopalpis*, teeth on claws very small, scarcely distinct. Forewings rich brown, mottled with white patches, mostly near costal border, and across wing near apical third, a more distinct spot in each apical cell; ends of veins on outer margin black, outer fringe partly brown, partly white; hind wings unmarked, veins brown. Forewing with radius showing just beyond crossvein a distinct bend. Hind wing with subcosta showing from its end a faint connection to radius.

Length, 3 mm.

FORMOSA, Taihoku, May 2 (*Gressitt*). Type, M. C. Z. No. 21763.

LEPIUM ENDERLEINI sp. nov.

Head yellowish brown, with moderately long white hair, vertex margin rather sharp; palpi brown; antennæ pale, moderately hairy; ocelli subequal, in a very broad low triangle, posteriors fully four times as far apart as from eyes. Forewings covered nearly uniformly with black and metallic scales; fringes long, costal one dense and towards tip fully one-fifth wing width, and those on outer part of hind margin nearly one-third wing width. Hind wings hyaline, veins nearly black, fringes black, very long on outer half of costa and outer margin; membrane in apical half of wing hairy.

Venation similar to that in *L. chrysochlora;* pedicel of cubital forks longer, radius and radial sector more widely separate at tips; hind wing slenderer and more pointed.

Length, 3.4 mm.

FORMOSA, Hori, June 6; Hassenzan, June 19 (*Gressitt*); Taihoku, June 4 (*Takahashi*). Type, M. C. Z. No. 21764; paratype in Takahashi collection.

PSOQUILLA MARGINEPUNCTATA Hagen.

Taihoku, September 8 (*Takahashi*), many specimens. Nearly all are of the typical short-winged form of both sexes; among them are four that have much longer forewings and well-developed hind wings. One of these is figured (Plate 2, fig. 14). The marginal spots are retained, but the dark is broken up by two irregular hyaline bands. Several of the veins towards the tip become somewhat irregular and sometimes have short lateral spurs. In the hind wing is a dark spot at the end of the cubitus. The head and other parts are as in the short-winged form, so I think there can be no doubt that they are long-winged forms of the same species.

PERLIDÆ

CERCONYCHIA BRUNNEA Klapalek.

Pianan, May 11; Hassenzan, June 22; and Taiheizan, May 8.

CERCONYCHIA LIVIDA Klapalek.

Urai, May 1 and 2; and Musha, May 18. The *Nogiperla* of Okamoto might be this genus; but his figure shows no radial crossveins; the species would be distinct from either of Klapalek's species.

PELTOPERLA FORMOSANA Klapalek.

Taiheizan, May 9.

KAMINURIA FORMOSANA Okamoto.

Urai, May 3 and 8.

TOGOPERLA ÆQUALIS sp. nov.

Male.—Above black; abdomen reddish yellow, venter and sternum yellowish; legs pale, tips of femora, upper edge of tibiæ and the tarsi dark; antennæ and palpi brown, former paler on basal part; wings brown, costal area pale yellowish as well as the veins here, other veins dark brown; a large pale spot each side of ocelli.

Female.—More yellowish on head, the large ocellar mark broadened in front, but hardly connected to the anterior spot, the M-mark pale; pronotum more or less pale brown in middle, black on sides, the deflexed sides black only on edge; wings more yellow-brown than in the male, but much darker than the yellow costal area; apical segment of abdomen pale.

Ocelli almost as near to eyes as to each other; eyes round, superior boss transverse, nearer to eye than to ocellus; pronotum a little broader than long, a trifle narrowed behind, anterior angles acute, hind angles almost square, median area not well marked, sides moderately rugose.

Forewings with about ten to thirteen costals, three or four subcostals, about seven median, and nine to eleven cubital crossveins; radial sector with two or three branches, the first sometimes from the crossvein; crossvein from radius to radial sector oblique; in hind wing about eight cubital crossveins; radial sector with two or three branches. Female with pronotum proportionally broader.

Male with sixth and seventh ventral segments each having a median patch of short, stiff brown hair; fifth dorsal segment a little swollen behind, roughened or spinulose near edge, and with a slight process each side bent downward; appendages

very elongate; with a small lobe at base of each. Abdomen of female ending in a median pointed part and a narrow hook each side; ventral plate swollen out narrowly over next segment and slightly emarginate at tip.

Male, length, 10 to 11 mm; forewing, 13 to 16; female, body, 14 to 15; forewing, 18 to 19.

FORMOSA, Shikayan and Pianan, May 11 and 12. Type, M. C. Z. 20196.

TYLOPYGE SIGNATA sp. nov.

Male.—Yellowish, thorax and abdomen more tawny; head with a large median black mark from ocelli to the M-line, a narrower black mark on clypeus; antennæ pale on basal part, dark beyond; palpi dark; pronotum with a broad black median stripe, broader behind, front, sides, and hind margin rather broadly black, thus leaving a large pale spot on each side of pronotum, deflexed sides black; notum somewhat darkened around scutelli; femora mostly yellow above, tip, and tibiæ and tarsi black; a median dark patch of hairs on fifth ventral segment, and between hind coxæ, but neither as large nor with so long hairs as in *T. planidorsa;* setæ pale on base, darker beyond. Wings brown, except yellow costal margins to both pairs; costal veins yellow, others dark brown; in some places the middle of the cells paler brown.

General structure like that of *T. planidorsa;* hind ocelli much smaller than in that species, scarcely larger than anterior ocellus, nearly as far apart as from eyes; superior boss larger than ocellus, oblique, and much nearer to eyes than to ocellus.

Pronotum broader than long, narrowed behind, front angles acute, hind corners rounded; median area moderately broad, rugose on sides, mostly towards middle. Forewings with about ten costals, two or three subcostals, six or seven median, and seven or eight cubital crossveins; radial sector with one branch, and one from the crossvein, lower branch of median forked beyond the crossvein; hind wings with about six cubital crossveins, radial sector with two branches.

Male with both sixth and eighth dorsal segments having a median patch of spinules on apical part of segment.

Length, 11.5 mm; forewing, 15.

FORMOSA, Urai, April 2. Type, M. C. Z. 20193.

Differs from *T. minor* in having costal area yellow, dark palpi, and spinules on the sixth as well as the eighth segment. The appendages are much slenderer than in *T. minor.*

TYLOPYGE PLANIDORSA Klapalek.

Rokki, May 12; and Hassenzan, June 25.

Genus SCHISTOPERLA novum

Two ocelli, far apart; head prolonged back of eyes more than length of eye, eyes rather small; no median furrow on back of head; lateral sutures nearly parallel and reaching back to superior boss, not touching eyes; pronotal side margins not deflexed so that pronotum is angulate on sides. Body rather long; wings moderately long, venation similar to that of *Neoperla*. Male genitalia simple, a hairy boss on ninth ventral, and appendages short, close together, and divergent. Ventral plate of female large.

According to Klapalek this would be an acroneurine because of the male genitalia, according to others a neoperline. The nearly parallel sutures on the metasternum reaching almost to the hind margin and the head structure distinguish it from both groups. Probably related to the American *Kathroperla* and *Paraperla*, all lacking the deflexed sides to pronotum, and with the head extended behind eyes; the American genera, however, differ in metasternal sutures, ocelli, sutures on head, and other details.

SCHISTOPERLA COLLARIS sp. nov.

Black; head dull black, a little reddish each side in front; pronotum black, sides broadly margined with yellow; notum dull black; abdomen brown, setæ scarcely paler; antennæ and palpi brownish; legs dark brown to black; wings dark brown, costal area with the veins here pale yellow, other veins dark brown.

Head broad in front, M-line with the middle part distinct, back of this a transverse impression; from anterior part of eye a line to the superior boss; ocelli at least six diameters apart; superior boss close by side of ocellus, and more than twice as large; surface of head with fine short hair. Pronotum broader than long, sides angulate in middle, median area rather wide, surface each side moderately rugose; abdomen elongate, slender, clothed with fine short hair, setæ short, bristly besides the fine hair.

Male appendages appear as two erect approximate pieces, above diverging and tips rounded; last dorsal segment reddish, with a forked, median black mark, and a black stripe each side, an elevated spot at end of each stripe. Ventral plate of female greatly extended, almost to tip of abdomen, with a distinct median notch.

Forewings with about ten costals, four subcostals, about ten median and nine cubital crossveins; radial sector with two branches beyond and one from crossvein; crossvein from radius to radial sector at right angles; the two branches of anal cell far apart at base; in hind wings six to eight cubital crossveins, radial sector with three branches or with two branches and one from the crossvein.

Length, 14 to 15 mm; forewing, 17 to 18.

FORMOSA, Taiheizan, May 6 and 7. Type, M. C. Z. No. 20190.

MESOPERLA CRUCIGERA Klapalek.

One female, 54 mm, from Rokki, May 15, is probably this species, which was described from a male; the markings on the thorax are not as distinct as described; the ventral plate is truncate, about three times as broad as long. The genus must be near *Acroneuria* as the metasternum shows the same Y-shaped suture.

KIOTINA LUCIDA Klapalek.

Hassenzan, June 24.

FORMOSITA HATAKEYAMÆ Okamoto.

Urai, April 30.

Key to the species of Neoperla.

1. Pronotum and head with distinct median black marks; venation scarcely paler on costal area .... 2.
   Pronotum and head scarcely, if at all, marked with black; venation distinctly paler on costal area .... 3.
2. Forewing scarcely 10 mm long .... *signatalis.*
   Forewing fully 18 mm long .... *klapaleki.*
3. Length of forewing about 10 to 12 mm .... *formosana.*
   Length of forewing about 16 to 18 mm .... *uniformis.*

NEOPERLA UNIFORMIS sp. nov.

Female.—Yellowish, not very clear, scarcely marked with dull brown. Ocelli on black spots, a brownish cloud over lower part of face; antennæ and palpi also yellowish; pronotum dull yellowish brown, rather darker on sides; abdomen pale throughout, also setæ; legs a little darker on upper edges and tips of tarsi; wings dull gray, costal area and veins there pale yellow, other venation rather dark brown.

Ocelli about two and one-half diameters apart, much farther from eyes; superior boss rounded, nearer to ocellus than to eye; pronotum broader than long, front corners acute, hind corners broadly rounded, middle area rather narrow, sides strongly rugose.

Forewing with about ten to twelve costals, three or four subcostals, about eight median and five cubital crossveins; three branches from radial sector beyond crossvein and usually one from crossvein. In hind wing about five cubital crossveins, two or three branches to radial sector.

Female with ventral plate not projecting, but indicated on margin by a slight median swelling.

Length, 13 mm; forewing, 17 to 18.

FORMOSA, Hassenzan, June 22; Urai, May 3; Funkito, June 8. Type, M. C. Z. No. 20195.

NEOPERLA SIGNATALIS sp. nov.

Female.—Pale yellowish; a prominent square black mark over ocelli and forward to clypeus, a triangular black spot on clypeus; antennæ and palpi yellowish brown; pronotum with a broad, median black stripe and the front and side borders narrowly black, deflexed sides black; notum rather brownish yellow; abdomen similar near tip above; wings gray, veins yellow gray, costals a little paler; legs pale, upper edges darker.

Ocelli small, about three diameters apart, only a little farther from eyes; pronotum broader than long, front corners acute, hind corners broadly rounded. Forewing with seven or eight costals, two or three subcostals, about six in both median and cubital series; radial sector with two branches; radial cell much shorter than radius to base. Hind wing with about six cubital crossveins, radial sector with two branches. Male with last ventral ending in a rather sharp point, the superior appendages reach forward to a very short extension of seventh segment.

Length, 8 mm; forewing, 10.

FORMOSA, Urai, June 1. Type, M. C. Z. No. 20192.

NEOPERLA KLAPALEKI sp. nov.

Female.—Pale yellowish; a large black spot in ocellar area, and a narrow black one on clypeus; pronotum with a broad black stripe through middle, the front and sides narrowly black; mesonotal humps dark; tip of abdomen scarcely darkened; legs pale, upper edges of femora and tibiæ, and the extreme tips of tarsi dark brown. Wings hyaline, not darkened, venation pale, costal veins only a little paler than others.

Ocelli of moderate size, about two diameters apart, about twice as far from the eyes; superior boss rather large, transverse, about as near to ocellus as to eye. Pronotum much broader than long, slightly narrowed behind, front corners acute, hind corners rounded, middle area plainly marked, side carina curved

at each end, surface of sides plainly roughened; tip of abdomen shows the last segment projecting in an even curve; ventral plate scarcely convex in middle.

Forewing with about eleven costals, four subcostals, six median and seven cubital crossveins; two branches from radial sector; crossvein from radius to sector not oblique, and interstitial with that from radial sector to medius, and of about the same length; radial cell almost as long as radius to base of wing; hind wing with eight cubital crossveins, two branches to radial sector.

Length, 15 mm; forewing, 19.

FORMOSA, Pianan, May 11. Type, M. C. Z. No. 20194.

NEOPERLA FORMOSANA Okamoto.

Rokki, May 16; Hassenzan, June 22 and 23; Suisha, June 1; Hori, June 6; Funkito, June 8. Common.

AMPHINEMURA FLAVICOLLIS Klapalek.

Hassenzan, June 22 and 27; Hori, June 9; Urai, April 1; Bukai, June 13; Sozan, March 29; Musha, May 18.

AMPHINEMURA NIGRITULA Navas.

Arisan, June 3 and 4; Taiheizan, May 9.

PROTONEMURA BREVILOBATA Klapalek.

Rokki, June 16; Sozan, March 29; Urai, April 1; Hori, June 9; Taihoku, March 27.

NEMOURA PLUTONIS sp. nov.

Female.—Jet black, polished, wings faintly paler in middle of some cells, clypeus triangular; ridge across at antennæ prominent; ocelli small, a little nearer to eyes than to each other; eyes large and prominent. Pronotum about as long as broad. Wings elongate, about six median and eight cubital crossveins; radial sector rounded at base, without stump of a vein; median arises longer than first median crossvein before radial sector, its base before first median crossvein nearly straight, not plainly curved; first anal vein bent in a long curve beyond anal cell; second anal vein forked more than length of end of anal cell beyond anal cell; subcostal crossvein beyond radial subcostal crossvein about twice the length of the latter vein.

Length, 10 mm; forewing, 11 to 12.

FORMOSA, Sozan, March 30, and Hassenzan, June 22. Type, M. C. Z. No. 20191.

RHOPALOSOLE DENTATA Klapalek.

Arisan, May 23, June 3; Moji, April 17; Hassenzan, June 22; Hori, June 8; Urai, April 1; Kusukasu, April 12; Musha, May 18; Taiheizan, May 6.

SIALIDÆ

PROTOHERMES COSTALIS Walker.

Rokki, May 13; Hori, June 19.

NEOCHAULIODES FORMOSANA Okamoto.

Antsu, April 28; Mount Kannon, April 28.

SIALIS KUMEJIMÆ Okamoto.

Several females, all from Taiheizan, May 8, are probably of this species, which was described from Okinawa Island.

RAPHIDIDÆ

RAPHIDIA FORMOSANA Okamoto.

Hassenzan, June 24; Arisan, June 4.

DILARIDÆ

DILAR (NEPAL) FORMOSANUS Okamoto and Kuwayama.

Similar in size and appearance to *Nepal hornei;* marks on forewings about the same; legs more distinctly marked with dark at tips of joints than in *N. hornei,* and the processes on antennæ rather darker than in that species; thorax dark on sides, pronotum with the usual row of four pale spots. On head the anterior wart plainly smaller than posterior warts (in *hornei* about equal in size) ; joints of antennæ becoming elongate sooner and the processes very plainly shorter than in *hornei;* for example, the fourth process in *hornei* more than reaches the base of antenna, while in this it is far short of that distance; male claspers larger and more elongate than in *hornei.* Forewing with thirteen subcostal crossveins, seven to nine radials, four branches to the second radial sector, four crossveins between first and second radial sectors, four between first radial sector and medius, the outmost of these crossveins a somewhat gradate row, but slanting obliquely outward behind, only two crossveins between median forks, five crossveins between lower medius and cubitus, and four crossveins between branches of cubitus. Hind wing with venation similar to that of *hornei,* but with only three or four crossveins between radius and radial sector (six or seven in *hornei*). Pupillæ hardly distinct.

Length of forewing, 8 mm; width, 3.

FORMOSA, Musha, May 20 (*Gressitt*).

Described from a female. The type was said to have but one radial sector; I have two males which have two, as all allied forms, and the wings are more banded than indicated in original description; however, it is not likely that there are two species in this section on Formosa.

DILAR TAIWANENSIS sp. nov.

Dull yellowish, with yellowish to tawny hair; some brownish on clypeus; second joint of antennæ brown below, processes dark brown; mesonotum with a dark brown spot in the middle; abdomen brown; legs with a distinct brown mark at knees, tip of tibia, and less distinctly at tips of the tarsal joints. Forewings faintly marmorate with pale brown, quite distinctly in apical part of costal area, fairly plain behind the cubitus, in the apical area rather faintly, in the midbasal area scarcely noticeable; pupillæ very distinct and surrounded by a brown cloud. Where the brown marks are at all plain they are arranged in narrow transverse bands, about a dozen in the area behind cubitus; where these marks touch veins the veins are brown, elsewhere pale; hind wings dull yellowish; no marks, except the one pupilla.

Forewings with eleven subcostal crossveins, not evenly spaced, about twelve radials, also unevenly spaced, on one wing five branches of radial sector, on the other, three branches; between medius and cubitus about seven to nine crossveins; between branches of cubitus five crossveins; between forks of first radial sector four crossveins; all crossveins irregularly placed, no semblance of rows.

Hind wing with first radial sector not united to second near base, but quite separate and with an extension back to base of medius; second radial sector with about five branches; basal cubital cell very elongate, more so than usual, two crossveins between medius and cubitus, one near base, the other towards tip; two median crossveins; two between first radial sector and medius, one near base, other far out towards tip; four crossveins between the two radial sectors, pupilla between second and third, eight radial crossveins, unevenly spaced; about twenty-eight costals; crossveins show little tendency to be in rows (so different from *nietneri, marmoratus, harmandi*). Vertex rather narrowly elevated, smooth middle area quite narrow, especially in front, hairy wart each side no wider than smooth space, an-

terior wart much smaller than others; antennæ with joints bearing long processes about as in *D. corsicus.* Pronotum in front with two subtriangular scalelike lobes.

Forewing, length, 13 mm; width, 5; hind wing, length, 11.5; width, 5.

FORMOSA, Arizan, June 4 (*Gressitt*). Type, M. C. Z. No. 20229.

CONIOPTERYGIDÆ

CONIOPTERYX ALBATA Enderlein.

Specimens from Taiheizan, Sozan, Sakahen, Musha, and Hassenzan, May and June, agree with this Japanese species.

MALACOMYZA PULVERULENTA Enderlein.

From Kuraru, Bukai, Pianan, Musha, and Hassenzan, in May and June.

In most cases the crossvein from subcosta to radius is interstitial with the radial crossvein, and sometimes the mediocubital crossvein is not its length before the fork of medius; the elevated rounded black spots on the mesonotum are very prominent.

CONIOCOMPSA FURCATA sp. nov.

Face brown, hairy; palpi black, short and thick, vertex elevated, smooth, yellowish; antennæ dull yellowish, thick, joints narrowed at base, clothed with pale yellowish hair. Notum dark brown, anterior lobes elevated, transverse polished; legs dull yellowish, femora much darker. Forewings with many large, often connected, pale brown marks; large ones over most of the basal part of space between subcosta and radius, and between radius and radial sector, spots over the three principal crossveins, and spots around or near the ends of various veins (some variation in the size and connections of these spots); hind wings unmarked.

Forewing with median vein plainly forked towards tip, basal part of medius very tenuous and indistinct, but the two enlarged spots for bristles plain; base of radial sector broken, apical part suddenly narrowed, radial and radial-subcostal crossveins interstitial, base of cubital fork very faint.

Hind wings with venation similar to that of *C. vesiculigera,* the median vein unforked, basal part indistinct but just before the crossvein a swelling for a bristle; branches of cubitus connected by a crossvein near margin.

Length, 3.5 mm.

FORMOSA, Hassenzan, June 27 (*Gressitt*). Type, M. C. Z. No. 20212.

OSMYLIDÆ

SPILOSMYLUS JAPONICUS Okamoto.

Suisha, June 1; Rokki, May 13 and 16; Kuraru, May 5; Chirifu, May 19.

This Formosan species has been identified by Esben-Petersen as *S. tuberculatus* of the Malay Peninsula, and, following him, by Nakahara. At about the same time Okamoto described *S. japonicus*, which is close to *tuberculatus*, and has, like that species, twelve radial and twelve cubital crossveins. The markings are also similar. *Spilosmylus modestus* from the Sunda Islands and the Philippines is also near, in fact *modestus* may be the same as *tuberculatus*, there being only minor differences in markings. The differences are: In *japonicus* (both Japanese and Formosan specimens) the first crossvein from median to radial sector ends on the sector before the origin of the first branch; in *tuberculatus* (and *modestus*) this crossvein ends out on the first branch of radial sector. In *japonicus* the bulla is plainly longer than high, while in *tuberculatus* (and *modestus*) the bulla is nearly circular.

HEMEROBIIDÆ

NOTIOBIELLA SUBOLIVACEA Nakahara.

FORMOSA, Hassenzan, June 22; Taihoku, May 2. LOOCHOO ISLANDS, Iriomote Island, August 20 and 21.

ANNANDALIA CURTA Needham.

Two from Hori, June 8, and Rokki, June 13; one from the Sauter lot sent by Esben Petersen as *maindronina* Navas. *Curta* is an older name. Quite possibly both are *iniquus* Hagen; but the three Hagen types differ from all the *curta* I have seen (including two from Peradeniya, Ceylon) in that the second of the gradate veinlets is more than its length before the first, and the third is more than its length beyond the fourth; in *curta* these veinlets form a much more even row.

NINGUITA DELTOIDES Navas.

Two from Arisan, June 2. These are not as evenly marked as the Japanese form; the wing is mostly pale, with many pale brown marks, and some darker marks along the subcosta, the middle and outer gradates are in a dark line (although three of the outer gradates are hyaline white); the inner gradates are not noticeably marked, and from the inner end of the series

there is a silvery white line curving back towards the hind margin of the wing, and then back to the base of the wing.

MEGALOMUS FORMOSANUS sp. nov.

Face pale; a dark band across below antennæ; antennæ and palpi pale, unmarked; vertex dark, as also pronotum and mesonotum; a pale spot on vertex by side of eye, one on anterior side of pronotum, and one on side of anterior lobes of mesonotum, the three spots in a row. Metanotum pale with a large brown spot each side and a long black one in the middle; pleura with some dark spots. Legs pale, front tibiæ dark near base and near tip; abdomen pale brown, lateral sutures black.

Wings with more or less distinct bands of brown, mostly oblique; one before first gradate series is the broadest; a dark brown spot just beyond stigma between radius and radial sector, a larger spot over several of the upper gradates of outer series, another near basal angle of wing, one before stigma; about eight smaller spots along radius, and three along cubitus, other smaller spots or dots on some veins; upper gradates of both series brown, and small brown spots along borders of wing. Hind wing with a cloud over upper outer gradates, and faint clouds at outer angle and middle of hind border.

Forewings broad as usual; venation very similar to the European *M. hirtus;* in hind wing the inner gradates nearer to base; in forewing seven, in hind wing six, branches of radial sector.

Expanse, 19 mm.

FORMOSA, Arisan, June 4. Type, M. C. Z. No. 20197.

Bestreta japonica Navas, said to be related to *Megalomus,* is a larger insect, the basal joint of antenna paler than rest, and other differences.

HEMEROBIUS SPINIGERUS sp. nov.

Head pale yellowish, a dark brown mark under each eye; antennæ pale yellowish, not darkened near tip; pronotum pale, broad, brown side margins; mesonotum also with broad, brown stripe each side, pale through middle; metanotum mostly dark, scutellum pale; abdomen pale brown; legs pale. Wings not much marked, veins with dark spots or dots, a larger mark on basal angle, and crossvein across cubitus dark brown; gradates dark.

Wings moderately narrow, costal area as narrow as in *H. humuli,* three radial sectors, last forked three times; six inner gradates, next to last much before last, seven outer gradates;

in both series each gradate well separated; crossvein between median and radius close to base. Hind wing with radial sector forked three times; three inner gradates, five or six outer ones.

Expanse, 16 mm.

FORMOSA, Koripapono, April 17; Shonoryo, June 11; Arisan, May 26. Type, M. C. Z. No. 20198.

In general appearance this is similar to *H. japonicus*, but the male genitalia are different.

MICROMUS NOVITUS Navas.

Two from Arisan, June 6; and Hassenzan, June 23.

MICROMUS SAUTERI E. Petersen.

Many specimens from Formosa and Iriomote Island.

CHRYSOPIDÆ

NACAURA MATSUMURÆ Okamoto.

One from Rokki, May 17.

NOTHOCHRYSA JAPONICA McLachlan.

Riran, April 20.

NOTHOCHRYSA UCHIDÆ Kuwayama.

One specimen of this fine species from Hori, June 16.

ANKYLOPTERYX OCTOPUNCTATA Fabricius.

FORMOSA, Hori, June 6. LOOCHOO ISLANDS, Iriomote Island, August 20.

ANKYLOPTERYX DOLESCHALI Brauer.

One from Iriomote Island, Loochoo Islands, August 20.

ANKYLOPTERYX DELICATULA sp. nov.

Body mostly green, venter, pleura, and face whitish. A dark brown spot each side under eye, and one each side on clypeus; each side on face close to eye and below antennæ is a dark dot; basal joint of antenna with a dark line on outer side, rest wholly pale; a black dot between bases of antennæ; pronotum pale in middle, green on sides, a dark spot on each side in front; mesonotum with a dark stripe on sides extending back along margins of mesoscutellum, a dark mark on sides of metascutellum; legs with a dark dot on front and middle tibiæ, and tips of tarsi dark.

Wings with green venation; basal subcostal crossvein and extreme base of some radial crossveins black, also near base the veins in two black spots black; the first of these spots is out

from the anal angle along the ends of four veins, second larger and over the ends of first anal vein up to third cubital cell and over base of that cell; along hind margin a few faint clouds at ends of three or four veins, and a similar faint cloud over the lowest of inner gradates, and still fainter clouds over some of the others; stigma with a short dark mark at base; outer end of some of costals also dark. Hind wing with a long dark margin from anals out to near middle of hind margin, often extending up a bit on the veins. In general structure, width of costal area, shape of divisory cell, curvature of radial sector, and other characters it is very similar to *octopunctata;* eleven radial crossveins, six cubital crossveins beyond divisory, five inner gradates, six to seven outer.

Forewing, length, 11 mm; width, 4.5. Type, M. C. Z. No. 20224.

LOOCHOO ISLANDS, Okinawa Island, August 31 (*Gressitt*).

Differs from all other species by the dark marks at base of wings, and from *octopunctata* by lack of dark in the stigma of hind wing.

Key to the species of Chrysopa.

1. Antennæ black towards base; head and antennæ at base reddish; gradates black; large species; hairs on veins very short........ *ruficeps.*
   Antennæ pale .... 2.
2. Venation wholly pale .... 3.
   Venation partly black, at least some of the gradates........ 4.
3. A dark spot each side on the face........ *anpingensis.*
   No such spot .... *peterseni.*
4. Mesonotum black across front, the black extending out on the costal margin for a short distance; three spots in a row on face; costal area very broad towards base........ *decorata.*
   Characters not as above........ 5.
5. Both first and second joints of antennæ with dark mark on outer sides, several spots on face; crossveins mostly black........ *cognatella.*
   At most a spot or stripe on basal joint, face with few marks, not so many crossveins black .... 6.
6. Face with a large X-mark between the antennæ, eight cubital crossveins beyond the divisory .... *furcifera.*
   Face without an X-mark .... 7.
7. Basal joint with a red or black mark on the outside; six cubital crossveins beyond the divisory .... 8.
   Basal joint without any marks, eight cubital crossveins beyond the divisory cell .... 9.
8. Cheeks with black spot; hardly any costal cells twice as broad as long .... *astur.*
   Cheeks unmarked; pronotum with dark dot each side; many costal cells fully twice as broad as long........ *eudora.*

9. Palpi pale; pronotum not dark on sides .... 10.
   Palpi mostly black; pronotum dark on sides; radial sector but little curved .... *marcida.*
10. Four black spots on the face .... *cognata.*
   No black spots on the face .... *adonis.*

CHRYSOPA COGNATELLA Okamoto.

LOOCHOO ISLANDS, Okinawa Island, July 6. Agrees well with description, except that there is no reddish margin to pronotum. Known previously from Japan proper.

CHRYSOPA DECORATA E. Petersen.

FORMOSA, Hassenzan, June 24; Shinten, April 3. LOOCHOO ISLANDS, Okinawa Island, August 31.

CHRYSOPA BASALIS Walker.

Several from Riran, April 19 and 20. This is *C. formosana* of E. Petersen and *C. peterseni* Okamoto. There is an earlier *C. peterseni* by Navas from Greece (1911).

CHRYSOPA ANPINGENSIS E. Petersen.

Taihoku, June 29. I believe that *C. boninensis* of Okamoto is the same form.

CHRYSOPA FORMOSANA Matsumura.

FORMOSA, Hassenzan, June 22; Kuraru, August 12. LOOCHOO ISLANDS, Iriomote Island, August 23 and 24. This is *C. sauteri* E. Petersen.

CHRYSOPA ADONIS sp. nov.

Pale yellowish or greenish; face, antennæ, and palpi unmarked, as also the pronotum. Wings with green longitudinal veins and many of the crossveins dark or black; gradates, costals on basal half, end forks of anal, and crossvein above to cubitus wholly black; radials and cubitals dark in the middle, some of the branches of cubitus to margin dark; outer forks unmarked. Stigma fairly distinct, although crossveins continue through it. Hind wings with gradates and some of costals partly or wholly dark, some radials dark in middle. Forewings not acute, with rather long hairs on veins, some on costals as long as cells; many costal cells two to three times as broad as long; twenty-five costals to stigma, fifteen to sixteen radials, eight cubitals beyond the divisory, six branches of radial sector before gradates, the first ending much before end of the divisory veinlet; nine gradates in each row, mostly not their length apart, the two rows slightly divergent above, outer row no nearer to margin than to inner row; divisory cell rather small, its base only

slightly oblique; postcubital area more than twice, almost thrice, as wide as cubital area. Hind wings with eight gradates in each row, subparallel, and the outer nearer to inner row than to margin; where radial sector meets medius a fairly large triangle.

Forewing, length, 17 mm; width, 6.

FORMOSA, Hassenzan, June 26 (*Gressitt*). Type, M. C. Z. No. 20228.

CHRYSOPA ASTUR sp. nov.

Greenish yellow, a pale yellow stripe through middle of dorsum; a large black spot on each cheek; palpi pale, somewhat marked with black; basal joint of antennæ with a black mark on outer side; thorax and legs unmarked. Forewings with largely greenish venation, but gradates black, costals partly dark at outer ends, the usual crossveins near base dark, and indistinctly dark on a few other veins; in hind wings only the gradates and costals dark.

Basal joint of antennæ short, broad, globose; pronotum a little longer than broad, narrowed in front, finely short-haired.

Forewings hardly acute; hairs on veins of moderate length; eighteen costals before stigma, ten to eleven radials, six cubitals beyond the divisory, four branches of radial sector before gradates, first ending much before end of divisory cell; four inner gradates, seven outer, each well separated from next of row, the two rows subparallel, hardly as near each other as outer to margin; radial sector only slightly sinuous, hardly any costal cells twice as broad as long, postcubital area one and a half times as broad as the cubital area.

Hind wing with three inner gradates, six outer, rows widely separate, the outer much nearer to outer margin than to inner row; a small elongate triangle where radial sector meets medius.

Forewing, length, 11 mm; width, 3.5.

LOOCHOO ISLANDS, Iriomote Island, August 24 (*Gressitt*). Type, M. C. Z. No. 20225.

CHRYSOPA EUDORA sp. nov.

Yellowish; palpi pale, last joint partly dark; basal joint of antenna with a red line on outer side, vertex with a red mark each side close to the eye; pronotum with a dark dot near middle of each side; mesonotum with a faint reddish spot on each anterior lobe. Forewings with mostly greenish venation; gradates very plainly black, several crossveins towards base of wing wholly black; costals, radials, and cubitals often dark at one or

both ends, marginal forks and branches of cubitus unmarked; stigma hardly noticeable; hind wings with some gradates partly dark, otherwise venation pale. Forewings acute at tip; hairs on veins of moderate length; twenty-five costals, twelve radials, six cubitals beyond divisory, five branches of radial sector before gradates, the first ends much before end of divisory cell; seven inner, eight to nine outer gradates, in subparallel rows, outer only a little nearer to margin than to inner row; third and fourth cubital cells each with two branches to margin, fifth with one (in most species it is the fourth that has but one, but it varies somewhat) ; many costal cells fully twice as broad as long; post-cubital area twice as broad as cubital area.

Hind wings with seven gradates in each row; where radial sector meets medius a much larger triangle than usual.

Pronotum much longer than broad, and much narrowed in front; basal joint of antenna not very globose, rather elongate.

Forewing, length, 15 mm; width, 5.

FORMOSA, Hassenzan, June 24 (*Gressitt*). Type, M. C. Z. No. 20226.

CHRYSOPA MARCIDA sp. nov.

Pale yellowish; a black mark each side on clypeus; palpi practically wholly black; antennæ unmarked, basal joint scarcely globose; pronotum with red-brown stripe on each side margin; notum unmarked, abdomen greenish. Forewings with veins largely pale, gradates dark, costals often partly dark, and usual crossveins near base dark; stigma not distinct, crossveins continuing right through in unbroken series.

Hind wings with gradates scarcely darkened, otherwise pale.

Forewings scarcely acute at tip; hairs on veins moderately long, some on costals equal the cells; about twenty-six costals to where the first subcostal starts, but nine more beyond to tip; fourteen radials, eight cubitals beyond the divisory, three or four branches of radial sector before gradates, the first ending much before end of divisory cell; nine or ten inner, eight outer, gradates, the inner row extending basad, outer row nearer to inner than to outer margin; postcubital area almost twice as broad as cubital area.

Hind wings with nine inner, eight outer gradates, the inner row with two gradates more basad. Pronotum scarcely as long as broad, much narrowed in front.

Forewing, length, 14 mm; width, 5.

FORMOSA, Arisan, May 25 (*Gressitt*). Type, M. C. Z. No. 20227.

Besides the above species, *Chrysocera formosana* Okam. is from Formosa, a form with long cerci at tip of abdomen of male. Navas has described two: *Mallada stigmatus,* 1924, which must be close to *C. peterseni,* but his figure of the stigma is broader than in that species; *Chrysopa feana,* 1929, which has a red line on the basal joint of antennæ, a red stripe on each side on the pronotum, the sides of meso- and metanotum dark. I have seen none so marked.

Chrysopa ruficeps McLach. is a large species with very short hairs on the veins, venation pale, but the gradates black. What Okamoto called *ruficeps* is said to have venation wholly pale; I doubt if the true *ruficeps* occurs on Formosa.

Chrysopa cognata is a well-known species of Japan proper, with four spots on the face.

Chrysopa furcifer is also a well-marked species of Japan.

Chrysopa remota Walk. is recorded by Okamoto. It was described from two specimens from the Navigators Islands (Samoa) and one from the Loochoo Islands. Petersen has described and figured the species from Samoa, and since the Loochoo Islands are over 4,000 miles from Samoa it is very improbable that the specimen from Loochoo Islands is of the same species as those from Samoa.

Chrysopa basalis Walk. was described from the Loochoo Islands; it is quite possible that it is the same as *C. peterseni.*

MYRMELEONIDÆ

NOUES ELEGANS sp. nov.

Head with a large black band above, below, and between antennæ from eye to eye; below, face pale, a narrow pale band above from eye to eye, rest of vertex black; palpi wholly pale, very short; antennæ almost black, some joints towards base very narrowly pale, basal and ring joints very pale. Pronotum pale, lateral margins behind sulcus, a narrow median line, a spot each side in front, and a streak in middle of each side of hind part black or almost so; hair quite long and mostly black. Anterior lobes of mesonotum black in front, pale above, large black spots inward of each wing, connected across base of scutelli, latter black through the middle; pleura pale, with a broad black streak, broader in front. Legs pale, femora dark near tips, especially above; front tibiæ dark in front, others with subbasal and apical dark marks; tarsi scarcely darkened. Abdomen with short, mostly black hair; venter pale, above dark, large pale mark on base of third segment and less distinctly

beyond, genital parts pale. Wings hyaline, venation black and white, longitudinal veins usually in streaks, crossveins usually wholly black or wholly white, most of the white ones in basal half, and in a large patch before and beyond rhegma; subcosta dark at base of each costal crossvein, about ten elongate and several smaller dark marks between subcosta and radius; several smaller clouds along cubitus, another at union of cubital fork and first anal vein, a still larger one over and up from rhegma; many marginal forks with small dark marks; stigma white, dark at base; in hind wings more veins dark; stigma white, a distinct cloud at rhegma, and traces of the spots between radius and subcosta. Antennæ long, rather widely separated at base; palpi very short; vertex somewhat elevated, truncated across middle, with a median impression. Legs slender, not very long, femora cylindrical; hind pair largely black-haired, others with some white hairs; front tarsus nearly as long as tibia, basitarsus equals next two joints together, but shorter than apical joint, spurs little more than two joints, only slightly curved; abdomen short.

Forewing with costals from middle out mostly forked, and connected by oblique crosveins, thus making two rows of cells; apical area with one row of gradates; four or five crossveins before radial sector, beyond about sixteen before stigma, two beyond stigma; eight or nine branches of radial sector, sector arising plainly before main cubital fork; basal cubital fork distinct; first anal bending up near tip and running into cubital fork; second anal in an even curve free of first anal, bending to touch third anal at one point; just beyond a crossvein back to first anal; third anal forked.

Hind wing with radial sector arising much before cubital fork, one crossvein before it; first anal bending down opposite cubital fork, and connected to the fork once, six branches to hind margin, second anal forked, upper branch connected once to first anal.

Body, length, 22 mm; forewing, length, 31; width, 9.

FORMOSA, Sakahen, July 13 (*Gressitt*). Type, M. C. Z. No. 20199.

This genus, described from Assam, belongs to the Dendroleoninæ, and to the tribe Dendroleonini; the hind basitarsus being a little shorter than the apical joint would bring it near *Glenoleon* and *Platyleon;* it looks very similar to the latter genus, but the second and third anals of forewing touching will readily separate it.

GLENUROIDES OKINAWENSIS Okamoto.

One specimen from Okinawa Island, Loochoo Islands, July 5.

DISTOLEON PARVULUS Okamoto.

One specimen from Okinawa Island, Loochoo Islands, July 5. This species was described as a *Myrmecælurus*, but Okamoto's figure shows that it is a *Distoleon*, in appearance very much like the others. It might be noted that *Feinerus formosanus*, of Navas, is the same as *Formicaleo formosanus* Okam., and both are doubtless the same as *Distoleon dirus*, which is widely spread. I have specimens of *D. dirus* from Foochow, China, as well as from the Malay Peninsula and other localities.

GAMA MATSUOKÆ Okamoto.

Several from Rokki, May 15 and 17; Hori, May 25, June 6. *Gama* is the first synonym of *Creagris*, which is preoccupied.

HAGENOMYIA ASAKURÆ Okamoto.

One from Sozan, June 29; I have others sent by Okamoto. *Hagenomyia brunneipennis* Peters. and *Myrmeleon ochraceopennis* Nakahara appear to be one species, related closely to *H. micans* of Japan proper.

MYRMELEON PUNCTINERVIS sp. nov.

Similar to *M. formicarius* in appearance, but smaller and with much slenderer wings. Color similar, but lateral scars on vertex pale; no median extension of black of face onto clypeus, black extending down at each lateral corner; pronotum with a narrow pale mark on each anterior side, and two small pale spots near middle of front. Wings with most of the crossveins, especially costals, and those in radial and median areas, and the longitudinal veins in radial area, with pale dots (in *formicarius* mostly wholly dark and the longitudinal veins with pale and dark streaks). Venation denser than in *formicarius*, thus between radius and radial sector there are 18 to 20 crossveins before stigma and four or five beyond stigma (in *formicarius* ten to twelve before stigma and two beyond). About 45 costals before stigma, nine or ten branches of radial sector. Forewing with a very distinct intercubital vein for a long distance parallel to cubitus, the area between in first part with but one series of cells, farther out two series.

Length, body, 25 mm; forewing, length, 27; width, 5.7.

FORMOSA, Hori, June 15 (*Gressitt*). Type, M. C. Z. No. 20200.

Esben Petersen records a small specimen of *M. formicarius* from Formosa; quite possibly it is this species.

SOGRA NEGLIGENS Navas.

One from Kuraru, May.

HEOCLISIS KAWAII Nakahara.

One from Kuraru, May.

ASCALAPHIDÆ

ACHERON TRUX Walker.

Many specimens, from various localities, some wholly clear-winged; others are partly or wholly dark.

SUPHALOMITUS FORMOSANUS Petersen.

Two males from Rokki, May 16; also one from Foochow, China (*Kellogg*).

SUHPALASCA FORMOSANA Okamoto.

One specimen from Formosa.

SUHPALASCA UMBROSA Petersen.

One male specimen, Kuraru, May 10, not fully colored; one female from Chirifu, May 19; two females from Hori, June 9; in none are the wings embrowned. A smaller female from Bukai, June 13, may be different; it has less white hair below.

MANTISPIDÆ

EUCLIMACIA BADIA Okamoto.

Two specimens from Kuraru, August 10 and 11.

Kuwayama compares it to *E. tagalensis;* the latter species differs not only in lacking the pronotal spots, but the posterior part of the pronotum is not as long as in *badia,* the tubercles are smaller, the dark costal streak is much narrowed, and the whole posterior part of the vertex is black.

EUMANTISPA TAIWANENSIS Kuwayama.

One specimen from Bukai, June 11, agrees closely with the description based on one specimen.

MANTISPA ORIENTALIS E. Petersen.

Two specimens from Hassenzan, June 24 and 26.

Three specimens, one each of Petersen, Stitz, and Kuwayama, had the pronotum entirely black; both of mine have a pair of very distinct pale stripes, reaching almost to hind margin; the larger specimen (forewing, 20 mm) is otherwise close to Petersen's description, the smaller specimen (forewing, 14 mm) has a pale stripe each side through the meso- and metanotum. The larger specimen has three branches from the first radial cell in one wing. In both the wings are plainly tinged with

pale yellowish brown, as Petersen noted. This will be the most useful character to determine the species.

MANTISPA FORMOSANA Okamoto.

Several from Rokki, May 13; Chirifu, May 18; and Kusukusu, April 12. The branches of the radial sector vary from three to five and are not always constant in opposite wings, so I think the varieties given by Stitz and Kuwayama are simply synonyms.

MANTISPA TRANSVERSA Stitz.

LOOCHOO ISLANDS, Iriomote Island, August 20 to 25. Several specimens.

This species was based on one specimen, and was unknown to Kuwayama in his revision. In most of these specimens the pale band across the anterior part of pronotum is broken into two rounded spots; the face has the usual black stripe; the antennæ, except the yellow basal joint, are black; scutelli mostly yellow, a yellow transverse mark inward from base of each wing; pleura with two large black marks on both meso- and metapleura. Coxæ and trochanters dark, rest of legs yellowish, except dark on tips of tarsi, and on basal part of hind tibia. Front legs largely yellowish, femora with brown streak inside, fainter outside, tibia with short, sometimes faint, streak outside, wholly brown, except upper edge, on inside.

The veins are all dark; in both wings the anal vein dark (in *formosana* the anal vein pale and inconspicuous). The pronotum is a little heavier than in *formosana,* faintly transversely wrinkled, but not scabrous or hairy as in *formosana.* Thus it belongs in the genus or subgenus *Mantispilla* as I have modified it. It is similar in thoracic marks to *M. spilonota* of Ceylon, but that species has no black band on the vertex.

Body, length, 8 to 11 mm; forewing, 7.5 to 10.

None of the specimens examined show the slightest sign of stripes on the pronotum; however, I would expect that they do occur.

ILLUSTRATIONS

Plate 1

Fig. 1. *Schistoperla collaris* sp. nov.; head and pronotum.
2. *Neoperla klapaleki* sp. nov.; ventral plate.
3. *Togoperla æqualis* sp. nov.; ventral plate.
4. *Schistoperla collaris* sp. nov.; male from below.
5. *Neoperla signatalis* sp. nov.; male genitalia.
6. *Schistoperla collaris* sp. nov.; male from behind.
7. *Schistoperla collaris* sp. nov.; ventral plate.
8. *Togoperla æqualis* sp. nov.; male genitalia.
9. *Neoperla uniformis* sp. nov.; ventral plate.
10. *Tylopyge signata* sp. nov.; male genitalia.
11. *Coniocompsa furcata* sp. nov.; fore and hind wings.

Plate 2

Fig. 12. *Peripsocus singularis* sp. nov.; forewing.
13. *Megalomus formosanus* sp. nov.; genitalia.
14. *Psoquilla marginepunctata* Hagen; long-winged form.
15. *Hageniella formosana* sp. nov.; forewing.
16. *Kolbia serialis* sp. nov.; forewing.
17. *Dilar taiwanensis* sp. nov.; forewing, prothoracic lobes, basal part of antenna.
18. *Lepium enderleini* sp. nov.; fore and hind wings.
19. *Hemerobius spinigerus* sp. nov.; genitalia.

Plate 3

Fig. 20. *Chrysopa adonis* sp. nov.; venation near divisory cell.
21. *Chrysopa eudora* sp. nov.; venation near divisory cell.
22. *Stenopsocus externus* sp. nov.; forewing.
23. *Cæcilius similaris* sp. nov.; forewing.
24. *Chrysopa marcida* sp. nov.; venation near divisory cell.
25. *Stenopsocus tibialis* sp. nov.; forewing.
26. *Paramphientomum nigriceps* sp. nov.; fore and hind wings.
27. *Hemicæcilius transversus* sp. nov.; forewing.
28. *Cæcilius confusus* sp. nov.; forewing.
29. *Chrysopa astur* sp. nov.; venation near divisory cell.
30. *Isophanes decipiens* sp. nov.; forewing.

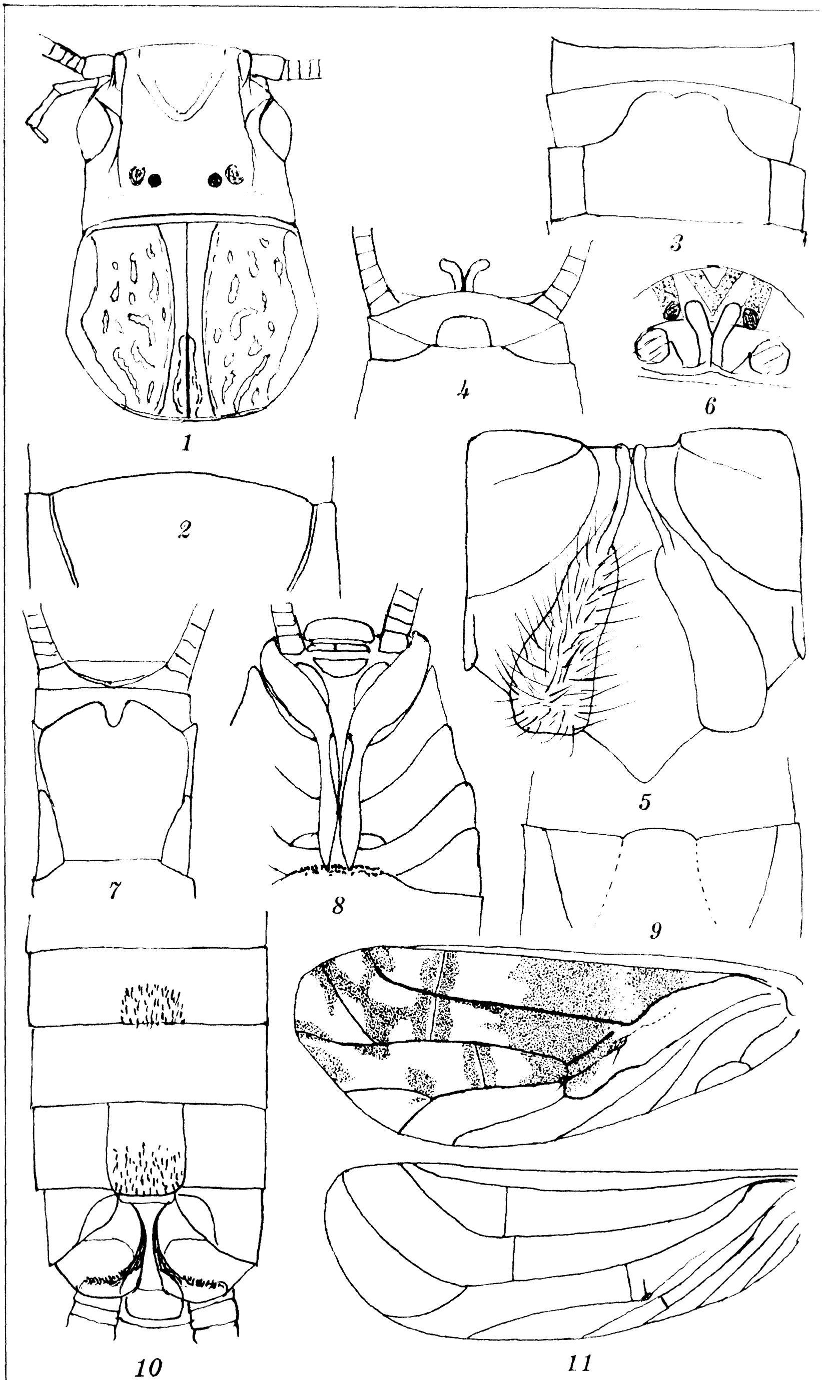

PLATE 1.

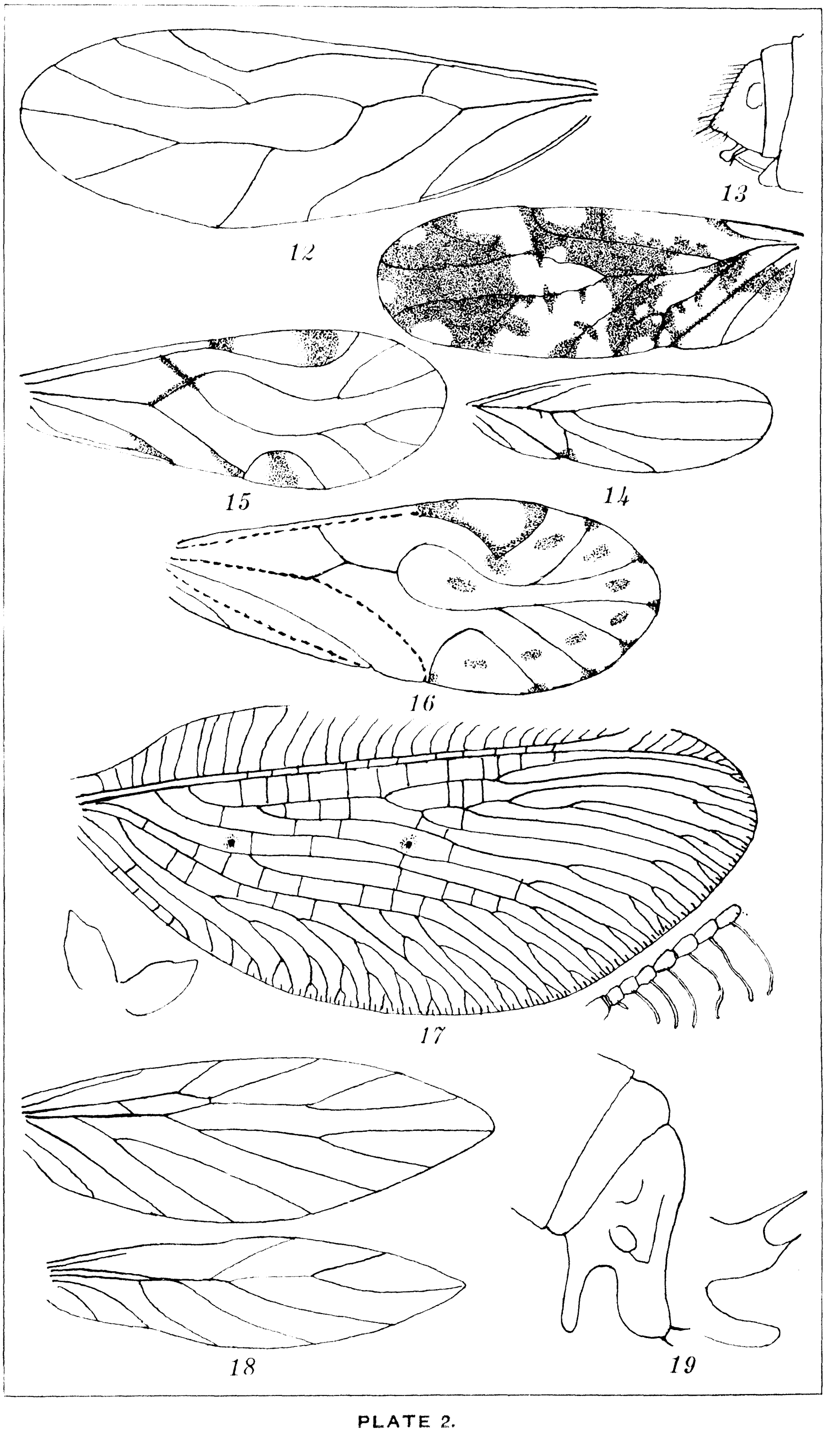

PLATE 2.

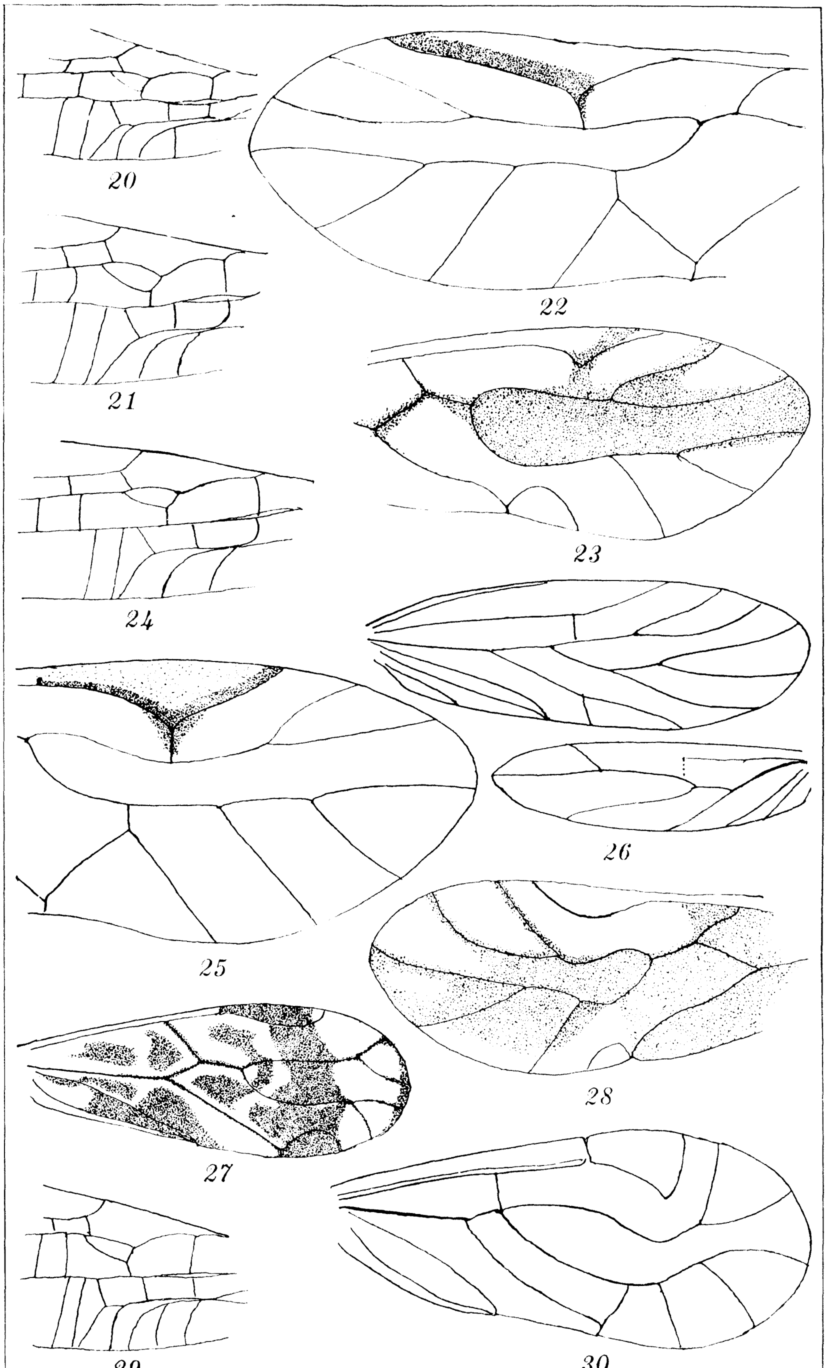

PLATE 3.

BOTTOM DIATOMS FROM OLHON GATE OF BAIKAL LAKE, SIBERIA

By B. W. Skvortzow

Of Harbin, Manchoukuo

EIGHTEEN PLATES

INTRODUCTION

Baikal Lake belongs to the Yenisei River basin of Siberia and extends from 51° 43′ to 55° 46′ north latitude and from 103° 44′ to 109° 57′ east longitude. The length of Baikal is about 623 kilometers, the breadth 74 kilometers, and the water area 33,000 square kilometers; its basin is 582,000 square kilometers. Baikal apears to be the deepest lake in the world, with a maximum depth of about 1,523 meters. Its bed is below sea level to 1,060 meters. In its great depth the bottom is covered with fine brown slime, but near the shore the bottom is stony and sandy. The water is fresh and very cold. According to A. V. Voznesenski, near the village of Listvenischinoe the water temperature is 0.1° C. in January, 0.01° C. in February, 0.0° C. in March, 1.2° C. in May, 4.5° C. in June, 6.2° C. in July, 7.1° C. in August, 7.9° C. in September, 6.9° C. in October, 3.6° C. in November, and 0.4° C. in December; the mean temperature is 3.2° C. The Baikal water is largely saturated with oxygen and has very little mineral matter in solution. During half of the year Baikal Lake is covered with ice.

BIOLOGY OF BAIKAL

The biology of Baikal is of great scientific interest. According to Prof. G. I. Wereschtschagin its fauna and flora include about 1,300 kinds of animals and plants with many species and genera endemic. The following are some of the inhabitants of Baikal: The Baikal seal (*Phoca siberica* Gmel.), a species related to the Caspian seal; about 35 species of fishes (Gomephoridæ and Cottocomephoridæ) with 1 family, 7 genera, and 17 species endemic. One peculiar fish is "Golomianka" (*Comephorus baicalensis* Dyb. and *C. dybovskii* Kor.) with a transpa-

rent and fat body. The Ostracoda, Amphipoda, and Trichoptera are all endemic. The gammarid Crustacea, over 300 species, are endemic except the common *Gammarus pulex*. The Copepoda are very numerous; one of them, *Epischura baicalensis*, is common in plankton and is also endemic, others are met with in Hanka Lake of the Maritime Province of Siberia, and *Harapacticella inopinnata* is a marine inhabitant. All of the Mollusca have thin shells and belong to endemic genera and species (*Benedictia, Baicalia,* and others). *Benedictia* has a series of species at various depths, small or very large, but all have thin shells. Gastropod Mollusca are represented by about 75 species, of which 68 species and several genera are endemic. Among the worms, 46 species of Tubellaria are known from this lake, and all are new to science. Over 100 endemic species of planarian worms were collected on bottom stones. Some Baikalian planarians are giants among the common European species. The polychæte worms, with *Manajunkia baikalensis*, are of marine origin. Over 30 oligochætes found in Baikal are very primitive, and this indicates their antiquity. Ten species of sponges are recorded, of which 8 are endemic. The sponges *Lubomirskia, Baikalispongia,* and *Veluspa* are very different from common fresh-water forms and belong to marine families. Bryozoa, Protozoa, and Infusoria are very peculiar, and almost all the species are known only from Baikal. According to Prof. G. I. Wereschtschagin, the Baikal fauna is not yet completely described. The plankton chiefly consists of an infusorian *Dybowskiana baicalensis;* a copopod, *Epischura baicalensis* Sars; an amphipod, *Macrochetopus brauickii* Dyb.; and two diatoms, *Cyclotella baikalensis* Skv. and Meyer and *Melosira baikalensis* (Meyer) Wisl. The flora like the fauna of Baikal Lake is rich. The recorded algæ are very numerous, including a number of endemics. Diatoms predominate and various green *Draparnaldia* form a thick growth on the bottom near the shore.

THE ORIGIN OF THE BAIKAL FAUNA AND FLORA

Several theories exist about the origin of Baikal plants and animals. Prof. L. S. Berg thinks that the fauna consists of (*a*) remains of a tertiary fresh-water fauna, formerly distributed all over Siberia and remaining only in Baikal Lake and in some other old fresh-water basins of Asia and Europe, and (*b*) various types of animals differentiated into vast numbers of species during the life of Baikal Lake, so that, while the ge-

nera are few, the species are very many. Prof. G. I. Wereschtschagin believes that in the Baikal fauna and flora the following elements can be detected: (*a*) Common Siberian or Palæarctic elements now of wide distribution in Siberia and Europe. To this group belong different animals and plants common in bays and in some parts of the southeastern shore. (*b*) Tertiary fresh-water remains, as thinks Prof. L. S. Berg. (*c*) The marine elements. To this group belong the Baikal relicts having relationship with marine forms. The marine elements penetrated Baikal in different geologic times. In the Quarternary period the Arctic Ocean in the time of boreal transgression reached 62° north latitude. The Baikal seal, some Amphipoda, and several fishes came from the north at that time. On the other hand from southeast of Baikal the ancient Jurassic sea reached Siberia, through Mongolia and northern China. Various sponges, amphipods, polychætes, and species of other orders came to Baikal from this ancient sea, which left in central Asia for a long time large brackish- and, later, fresh-water basins. In consequence of new conditions the Jurassic fauna was reduced, and when conditions became favorable it evolved into many species, in the absence of competition. (*d*) Finally, the elements of indistinct origin without distinct relationship with recent or fossil forms. *Comephorus baicalensis* and *C. dybowskii,* two peculiar fishes, belong to the last group.

THE HISTORY OF BAIKAL DIATOMS

The first list of Baikal diatoms was given by R. Gutwinski in 1891. He examined the collection made by Prof. B. Dybowski in 1877. Nearly all the diatoms listed by R. Gutwinski are cosmopolitan forms, as follows:

Pinnularia gibba var. *Peckii.*
Pinnularia hemiptera.
Pinnularia mesolepta var. *stauroneiformis.*
Navicula elliptica.
Navicula cocconeiformis.
Navicula levissima.
Navicula limosa var. *truncata.*
Navicula tumida var. *subsalsa.*
Navicula Carassius.
Navicula rhynchocephala var. *brevis* and var. *dubia.*
Navicula appendiculata.
Navicula cryptocephala.
Navicula firma var. *major.*
Navicula Peisonis.
Navicula binodis.
Navicula sphaeroplora.
Navicula quarnerensis.
Navicula Rostellum.
Navicula producta.
Stauroneis Meniscus.
Stauroneis lanceolata.
Stauroneis Crucicula.
Schizostauron tatricum.
Schizonema viridum.
Cymbella Ehrenbergii.
Cymbella Gregorii.

Cymbella cymbiforme.
Cymbella Naviculiformis.
Cymbella gastroides subsp. *substomatophora.*
Encyonema ventricosum.
Amphora ovalis.
Amphora lineolata.
Cocconeis Plancentula.
Cocconeis marginata.
Cocconeis striolata.
Cocconeis salina.
Gomphonema dichotomum.
Gomphonema capitatum.
Gomphonema acuminatum var. *coronatum.*
Gomphonema olivaceum.
Gomphonema intricatum.
Gomphonema fractum.
Gomphonema assymetricum.
Achnanthidium exile.
Achnanthidium coarctatum.
Denticula thermalis.
Denticula sinuata.
Nitzschia thermalis.
Nitzschia parvula.
Nitzschia tenuis.
Nitzschia communis var.*minuta.*
Rhoicosphenia curvata.
Surirella biseriata.
Surirella Smithii.
Surirella nobilis.
Campylodiscus spiralis.
Odontidium Harrisonii.
Odontidium mesodon.
Meridion circulare.
Fragilaria capucina.
Fragilaria virescens.
Synedra lunaris var. *genuina* and var. *campyla.*
Synedra bilunaris.
Synedra gracilis.
Synedra Vaucheriae.
Tabellaria flocculosa var. *ventricosa.*
Epithemia turgida var. *genuina.*
Epithemia Sorex.
Epithemia gibba.
Epithemia Zebra var. *genuina* and var. *saxonica.*
Epithemia Porcellus.
Eunotia Diodon.
Eunotia bidens var. *Dybowski.*
Eunotia Papillo.
Melosira granulata.
Melosira tenuis.
Melosira hyalina.
Melosira subflexilis.
Orthosira arenaria var. *typica* and var. *granulata.*
Orthosira Roeseana.
Cyclotella operculata.
Cyclotella Kuetzingiana.
Cyclotella Astraea.
Ceratoneis lunaris.

In this list I left the original nomenclature of R. Gutwinski. Four new forms are reported by him from Baikal but not figured. The first one, *Cymbella gastroides* subsp. *substomatophora,* is *Cymbella tumida* or a variety of *Cymbella Stuxbergii.* The next, *Eunotia bidens* var. *Dybowski,* is a large biconstricted diatom. The third one, *Schizostauron tatricum,* according to P. T. Cleve, is identical with *Navicula pupula,* and the last, *Orthosira arenaria* var. *typica* and var. *granulata,* all belong to *Melosira arenaria.* R. Gutwinski states that *Cyclotella Astraea* and *Melosira arenaria* were the commonest diatoms in the lake. He found *Cyclotella Astraea* at depths of from 10 to 1,000 meters. I suggest that this *Cyclotella* belongs to our *C. baikalensis.*

The next very accurate list of about 200 diatoms from Baikal was given by Prof. V. Dorogostasky in 1904, with *Navicula*

lata fo. *major*, *Gomphonema dentata*, and *Surirella Baikalensis* described as new. The first one can be named as *Pinnularia lata*, the next *Didymosphenia dentata*—one of the largest and stoutest diatoms known as endemic in Baikal. *Surirella Baikalensis* of Dorogostaisky I have not yet seen in my slides. Several other works, dealing with the diatom flora of Baikal Lake, appeared during 1922–1929. In 1922 Prof. K. I. Meyer reported 112 forms with a description of new *Melosira islandica* var. *baikalensis*. In 1924 S. M. Wislouch gave the diagnoses of *Melosira baikalensis*, *Gomphonema quadripunctatum* and var. *hastata*, *Cymbella Ehrenbergii* var. *Gutwinskii*, and *Cymbella Stuxbergii* var. *intermedia*. In 1925 appeared an account by Prof. K. I. Meyer and L. B. Reinhard with the following new diatoms: *Cyclotella compta* var. *radiosa* fo. *major*, *C. striata* var. *magna*, *Cymbella cistula* var. *baicalensis*, and *C. cistula* var. *excelsa* fo. *lata*.

The late Prof. A. H. Henckel was the first, in 1925, to note the presence of a large *Coscinodiscus* in Baikal Lake. In 1927 Prof. K. I. Meyer found *Coscinodiscus* frustules in samples collected near Salenga River and stated that these valves are fossils transported by the river to the lake. The author of this paper, together with Prof. K. I. Meyer in 1928, published a preliminary contribution to the diatoms of Baikal Lake with a list of about 450 diatoms among which were 160 new species and forms. The present paper is a new report on Baikal diatoms based on a little bottom sample collected by Prof. K. I. Meyer at the depth of 33 meters near the Olhon Gate of Baikal Lake July 29, 1916. I have examined about a hundred microscopic slides from this place and have taken great care to identify and illustrate the forms and to correct the mistakes of my previous work. The result was unexpected; I give 304 species, varieties, and forms, among which 148 are new. The paper includes detailed descriptions and drawings of almost all the forms. The present bottom sample contained abundant spicules of sponges and many individuals of large *Cyclotella baikalensis* and *Didymospenia geminata*.

THE DIATOM FLORA OF BAIKAL

The diatom flora of Baikal Lake is easily recognizable as an Arctic one. Its forms are large and very beautiful, with a predominance of naviculoid forms of colder water. This robust development is due mainly to the low temperature, low mineral content, high oxygen, abundant nourishment, and strik-

ing transparency of the Baikal waters. These conditions are quite unique, and it is not surprising that the diatom flora is rich and peculiar. Baikal is a cold arctic lake and has one of the richest bottom diatom floras known, both in number of individuals and in diversity of species. Two-thirds of the diatoms from the bottom material from Olhon Gate belongs to the Naviculaceæ (196) forms, with the large genera *Navicula, Amphora, Cymbella,* and *Gomphonema.* The genus perhaps showing a markedly strong development is *Amphora,* which contributes the relatively large number of 18 forms. About two-thirds of the Baikal flora, as listed in the present paper, is endemic. The present study shows a certain similarity of the Baikal diatoms to those of Tanganyika Lake, Africa; to Neogene fresh-water floras of Nippon; to Tertiary diatom floras of Hungary; to the recent flora of Demerara River, Paraguay, South America; and to some forms widely represented in oceans. All this can be explained only by the help of Prof. G. I. Wereschtschagin's theory of the origin of the Baikal fauna and flora. The 304 Baikal diatoms, as to origin, can be classified in five groups: (*a*) Siberian and subalpine elements, (*b*) Tertiary fresh-water remnants and species of tropical origin, (*c*) marine elements of marine relicts, (*d*) brackish-water species, and (*e*) elements of uncertain origin.

The first group is the largest, with about one-half of the recorded species. The second, with Tertiary fresh-water remnants or relicts and species of tropical origin, contains about 31 forms. The third group, with marine elements, contains only 6 or 7 species. The last—the elements of indistinct origin—is represented by a large series of Baikal endemics to which I have not yet found relationships. Herewith I give these preliminary lists, as follows:

(A) SIBERIAN AND SUBALPINE ELEMENTS

Melosira arenaria and var. *baikalensis.*
Stephanodiscus Hantzschii.
Stephanodiscus astræa var. *minutula.*
Tetracyclus lacustris.
Tabellaria fenestrata.
Opephora Martyi and var. *baikalensis.*
Ceratoneis arcus.
Fragilaria pinnata and var. *baikalensis.*
Synedra ulna and its varieties.
Synedra acus and its varieties.
Synedra Vaucheriæ var. *capitellata.*
Synedra rumpens.
Eunotia praerupta and var. *inflata.*
Cocconeis placentula var. *lineata* and var. *baikalensis.*
Cocconeis diminuta.
Eucocconeis onegensis.
Achnanthes Clevei var. *rostrata.*

Achnanthes Oestrupii and var. *minuta.*
Achnanthes baikalensis.
Achnanthes lanceolata and its varieties.
Achnanthes Peragallii.
Rhoicosphenia curvata.
Frustulia rhomboides var. *amphipleuroides.*
Gyrosigma Spenseri var. *nodifera.*
Gyrosigma acuminatum var. *baikalensis.*
Caloneis Zachariasi and its varieties.
Caloneis latiuscula and its varieties.
Caloneis silicula and var. *major.*
Caloneis Schumanniana and its varieties.
Caloneis ignorata.
Neidium dilatatum and fo. *curta.*
Neidium dubium and its varieties.
Neidium affine var. *baikalensis.*
Neidium lanceolata.
Diploneis ovalis and var. *nipponica.*
Diploneis domblittensis and var. *baikalensis.*
Diploneis puella and var. *baikalensis.*
Diploneis Boldtiana var. *baikalensis.*
Diploneis elliptica var. *ladogensis.*
Diploneis marginestriata var. *nipponica.*
Diploneis baikalensis.
Diploneis Meyeri.
Diploneis turgida and var. *bipunctata.*
Diploneis lata and its varieties.
Stauroneis phœnicenteron.
Stauroneis anceps var. *baikalensis.*
Stauroneis baikalensis.
Navicula cuspidata.
Navicula arguens.
Navicula americana.
Navicula bacillum.
Navicula pupula and its varieties.
Navicula fluens and its varieties.
Navicula silicea.
Navicula delicatula.
Navicula atomus.
Navicula costulata.
Navicula costuloides.
Navicula cryptocephala and its varieties.
Navicula rhynchocephala.
Navicula lanceolata and its varieties.
Navicula gracilis.
Navicula pseudogracilis.
Navicula torneensis var. *aboensis.*
Navicula hasta.
Navicula gastrum.
Navicula vulpina.
Navicula tuscula.
Navicula Meyeri.
Navicula anglica.
Navicula exigua.
Navicula rostellata.
Navicula placentula and its varieties.
Navicula menisculus.
Navicula suboculata and its varieties.
Navicula acuta.
Navicula lacustris and its varieties.
Navicula scutelloides var. *baikalensis.*
Navicula amphibola var. *curta.*
Navicula dahurica.
Pinnularia molaris.
Pinnularia leptosoma.
Pinnularia gibba var. *baikalensis.*
Pinnularia major and fo. *minor.*
Cymbella Hustedtii.
Cymbella amphicephala var. *unipunctata.*
Cymbella navicula.

Cymbella lacustris fo. *baikalensis.*
Cymbella sinuata.
Cymbella ventricosa.
Cymbella heteropleura var. *minor.*
Cymbella cuspidata.
Cymbella Ehrenbergii.
Cymbella Meisteri.
Cymbella Gutwinskii.
Cymbella prostrata.
Cymbella parva.
Cymbella cistula with its varieties.
Cymbella Stuxbergii.
Cymbella capricornis.
Amphora ovalis and its varieties.
Amphora Normanii.
Amphora perpusilla.
Amphora mongolica and its varieties.
Amphora costulata.
Amphora sibirica and var. *gracilis.*
Didymosphenia dentata.
Didymosphenia geminata and its varieties.
Gomphonema quadripunctatum and its varieties.
Gomphonema olivaceum.
Gomphonema innata and var. *elegans.*
Gomphonema intricatum and its varieties.
Gomphonema ventricosum.
Gomphonema firma.
Gomphonema delicatula.
Gomphonema lanceolatum and var. *capitata.*
Epithemia all species.
Rhopalodia gibba and var. *mongolica.*
Nitzschia all species recorded.
Cymatopleura all species.
Surirella linearis and var. *helvetica.*
Surirella biseriata var. *bifrons* fo. *punctata.*
Surirella granulata.
Surirella turgida fo. *baikalensis.*
Surirella gracilis.
Surirella didyma var. *minor.*
Surirella uninodes.
Surirella unidentata.
Surirella conifera and var. *punctata.*
Surirella Lacus Baikali and its varieties.
Surirella paucidens and var. *punctata.*

(B) TERTIARY FRESH-WATER REMAINS AND SPECIES OF TROPICAL ORIGIN

Melosira baikalensis, abundant in Baikal Lake and as fossil near Moscow. A remnant of glacial flora.

Fragilaria spinosa, a species akin to *F. robusta* fossil from Pensacola and to large marine *Opephora.*

Fragilaria Lacus Baikali, also akin to marine *Opephora* species.

Eunotia submonodon, known from Columbia River, Oregon, North America, and recently reported from Onega Lake, northern Europe.

Eunotia Clevei, abundant in Baikal. Recent in Ladoga and Onega Lakes in Europe, recent in southern China, and as a fossil in Sweden, in the State of Washington, North America, and in Neogene deposits in Nippon.

Eunotia Lacus Baikali, a species related to *E. Clevei,* may be also regarded as a relict.

Achnanthes calcar, recent in Europe, common as a fossil from the *Ancylus* epoch.

Gyrosigma baikalensis, akin to *G. distorum* and var. *Parkeri,* known from marine and brackish waters.

Caloneis simplex, a new species, akin to *C. nipponica* from Biwa Lake, Nippon.

Diploneis subovalis var. *baikalensis*. The type is reported from New Zealand.

Navicula confervacea var. *baikalensis*. The type is common in tropical regions.

Navicula subhamulata var. *parallela*. Reported by me from Biwa Lake, Nippon.

Navicula antiqua, a new species from Baikal; akin to *N. maeandrinoides*, a fresh-water fossil from Columbia River, Oregon, North America.

Navicula cingens, also a new diatom, connected with the previous species.

Navicula magna and its varieties, a diatom of very primitive structure.

Navicula vulpina var. *oregonica*, known as a fossil from Oregon, North America.

Navicula Lacus Baikali and its varieties, a very distinct species closely related to *N. Haueri* of Grunow, from brackish-water fossils of Hungary. Another related species, *N. Phi*, is a marine species from Seychelles.

Navicula subplacentula var. *baikalensis*, a very distinct diatom, closely related to *N. subplacentula* from the bottom of Tanganyika Lake, Africa.

Navicula annulata var. *baikalensis*. The type is known from Demerara River, South America.

Navicula Wislouchii, known only from Baikal, is related to *N. scoliopleuroides*, known from thermal waters of Budapest.

Pinnularia Lacus Baikali and the related species *P. abnormis* and *P. viridissima*, all three have distinct, peculiar, central pores and are very primitive forms; they are probably remains of Tertiary time.

Cymbella turgida, a species common in tropical countries.

Cymbella inelegans var. *baikalensis*. The type is known as a fresh-water fossil.

Cymbella australica fo. *elongata*. The type is known from Australia, Nippon, New Zealand, and Hanka Lake of the Maritime Province of Siberia.

Amphora delphinea, known from fresh water from Demerara River, South America, and var. *minor* from Grand Pond, North America, and also from Demerara River and from Kizaki Lake, Nippon.

Surirella margaritifera of Hustedt, known from fresh water of Tanganyika Lake, Africa.

Surirella Nyassæ var. *baikalensis*. The type is known from plankton of Nyassa Lake, Africa.

Surirella acuminata var. *baikalensis*, a very distinct species. The type is reported from fresh water, Tanganyika Lake, Africa.

Campylodiscus spp. of Baikal, all new to science; probably all of them are relicts of Tertiary time.

(C) MARINE ELEMENTS OR MARINE RELICTS

Cyclotella baikalensis, abundant in Baikal. Closely related to *C. stylorum* from the seashore of tropical regions and nearly akin to *C. striata*, common in marine and brackish waters.

Coscinodiscus radiatus, a marine species very common in the Caspian Sea. As thinks Prof. K. I. Meyer, large *Coscinodiscus* in Baikal Lake are fossils, brought by rivers.

Neidium Lacus Baikali, a distinct species closely related to *Navicula Kellerii* of Pantocsek, known as a marine fossil from Hungary.

Caloneis relicta, akin to *C. permagna* from brackish water of North America.

Amphora obtusa var. *baikalensis.* The type is known from the North Sea and the Atlantic and Indian Oceans.

Amphora Proteus var. *baikalensis.* The type is widely distributed in oceans.

Surirella prehensilis, a new diatom akin to *S. curvifacies* known from marine waters.

(D) BRACKISH-WATER SPECIES

Navicula crucicula var. *obtusata.*
Navicula anglica var. *subsalsa.*
Navicula peregrina and var. *kefvingensis.*

(E) ELEMENTS OF INDISTINCT ORIGIN

Eucocconeis baikalensis.
Achnanthes Lacus Baikali.
Achnanthes profunda.
Achnanthes Meyeri.
Achnanthes striata.
Achnanthes hastata.
Caloneis delicatula.
Navicula unipunctata.
Navicula paradoxa.
Navicula granulata.
Navicula delicatula.
Pinnularia pectinalis and var. *rostrata.*
Pinnularia crassa.
Amphora rotunda.
Surirella oöphora.

DIATOMS FROM OLHON GATE, BAIKAL LAKE

MELOSIRA BAIKALENSIS (K. Meyer) Wislouch. Plate 1, figs. 1 to 12.

Melosira baikalensis (K. Meyer?) Wislouch, S. WISLOUCH, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees, Bericht d. Deutsch. Bot. Gesellsch. 42[a] (1924) 165.

Melosira islandica O. Müll. var. *baicalensis* K. Meyer, K. MEYER, Quelques recherches scientifiques sur la flore des algues du lac Baikal, Journ. Moscow Branch of Russian Bot. Soc. 1 (1922) 7, 8, 20.

Melosira polymorpha Bethge subsp. *granulata* (Ralfs) Bethge var. *baicalensis* (Wisl.) Bethge, H. BETHGE, Melosira und ihre Planktonbegleiter (1925) 35.

Melosira baicalensis (K. Meyer) Wislouch, SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 4, pl. 1, fig. 1; A. P. SKABITSCHEWSKI, Über die Biologie von Melosira baicalensis (K. Meyer) Wisl., Russisch. Biologisch. Zeitschrift (1929) 93–114, pl. 3.

Melosira baicalensis (Meyer) WISL. in P. J. Wertebnaja, Über eine relikte Algenflora in den Seeablagerungen Mittelrusslands, Archiv für Hydrobiologie 20: 124–133, Abt. 1.

Frustules robust with cell wall about 0.0015 to 0.002 mm thick. Height of frustules, about 0.038 to 0.072 mm; breadth, 0.0045 to 0.0368. Alveoli in parallel or slightly oblique striæ, 7.5 to 9

in 0.01 mm; alveoli in rows, about 3 to 7.7 in 0.01 mm. Alveoli near the discus sometimes form longitudinal lines. Sulcus indistinct, forming a thicker siliceous ring from the inside part of the frustule. Pseudosulcus also indistinct. Auxospores round, sporangial frustule as in *Melosira italica* with thick cell wall and fine alveoli. A very distinct and variable species. The young immature and mature frustules are so different that they seem to comprise several different forms. According to the size and the shape of alveoli three forms can be recognized, as follows:

MELOSIRA BAIKALENSIS (K. Meyer) Wislouch fo. TYPICA fo. nov. Plate 1, figs. 1. 2, 4 to 6, and 10 to 12.

Alveoli small or large, irregular on the cell wall.

MELOSIRA BAIKALENSIS (K. Meyer) Wislouch fo. OBLONGA-PUNCTATA Skv. and Meyer. Plate 1, fig. 8.

Melosira baikalensis (K. MEYER) Wisl. fo. *oblonga-punctata* Skv. and Meyer, SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 4, pl. 1, fig. 1.

Frustules with oblong parallel alveoli. Uncommon.

MELOSIRA BAIKALENSIS (K. Meyer) Wislouch fo. COMPACTA fo. nov. Plate 1, figs. 3, 7, and 9.

Frustules with large and very thickly disposed alveoli. Common.

Melosira baikalensis is a very abundant species in Baikal. In plankton it is found, according to A. P. Skabitschewski, during the whole year with the maximum in spring and at the beginning of summer. Besides Baikal, *Melosira baikalensis* was noted also in Dalai-nor Lake in the western part of northern Manchuria and as a fossil in lake deposits near Moskow, in European U. S. S. R.

MELOSIRA BINDERANA Kütz. Plate 1, figs. 24 and 25.

Melosira Binderana Kütz., FR. HUSTEDT, Die Kieselalgen (1927) Lief. I, 246–248, fig. 103.

Frustules barrel-shaped and slightly siliceous. Frustule breadth, 0.0034 to 0.012 mm. Height of cell-half about 0.0021 to 0.0042 mm. Sulcus and kollum absent. Frustule cell wall hyaline with one row of distinct beads near the discus rim. Discus denticulate at the junction of the frustules. Very common. A plankton diatom known from the northern part of Europe and common in alpine lakes of Nippon.

MELOSIRA ARENARIA Moore. Plate 1, figs. 16 and 26.

Melosira arenaria Moore, A. SCHMIDT, Atlas Diatom. (1893) pl. 179, figs. 15–20.

Frustules box-shaped, closely joined together, forming long bands. Frustule breadth, 0.042 to 0.06 mm. The height of cell-half 0.007 to 0.012 mm. Sulkus and pseudosulkus indistinct. Discus rim denticulate at the junction of the frustules. Outer area of the discus forming a broad band three-fourths the radius in width, strongly marked with closely radiating costæ, 9 to 12 in 0.01 mm. The central area punctate with irregular dots. Frustule cell wall crossed by a fine line system of small puncta, 21 to 22 in 0.01 mm. Common.

MELOSIRA ARENARIA Moore var. BAIKALENSIS var. nov. Plate 1, figs. 15, 23, and 28.

Melosira scabrosa OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. Hedwigia 43 (1909) 93, pl. ?, fig. 20.

Differs from the type in the shape of diskus view. Outer area of the discus forming a band one-third to one-fourth the radius in width, strongly marked with closely set radiating costæ, 4 to 7 in 0.01 mm, and at the same time with a fine system of crossed lines, 18 to 20 in 0.01 mm. Central area hyaline with irregular blotches in the central part. Breadth of the frustules, 0.051 to 0.072 mm. Variety *baikalensis* is common in Baikal and reported from Kossogol Lake.

MELOSIRA ARENARIA Moore var. BAIKALENSIS fo. ORNATA fo. nov. Plate 1, fig. 14.

Dots on the surface of radiating costæ of discus rim.

MELOSIRA ARENARIA Moore var. BAIKALENSIS fo. PUNCTATA fo. nov. Plate 1, fig. 22.

A series of small and distinct puncta disposed in one longitudinal line from the zone view of the valve.

CYCLOTELLA BAIKALENSIS Skv. and Meyer. Plate 3, figs. 4, 6 to 16, and 20; Plate 3, figs. 1, 2, 4, 5, and 11.

Cyclotella baikalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 5, pl. 1, figs. 3, 4.

Cyclotella striata (Kütz.) Grun. var. *magna* K. MEYER and L. REINHARD, Contribution a la flore algologique du lac Baikal et de le Transbaikalie. Bull. Moscou Nat. Hist. Soc. (1929) 207.

Valve circular; consisting of a large central area, two-thirds the diameter of the valve and a rim one-third the valve diameter. One-half of the large central area is convex or rarely

convex in the central part. All of the central area is covered with dots irregularly distributed over the entire valve and sometimes covered also with small puncta or an irregular network. The dots are of different sizes, small or large. The outer rim, or area, is strongly marked with closely set, radiating costæ. The costal zone can be divided into three parts: The narrow marginal rim with costæ 9 to 10 in 0.01 mm; the middle rim also with enlarged costæ, sometimes forming a loculiferous rim of dark striæ, 2 to 5 in 0.01 mm; and the third, central part with long, radiating, fine striæ, 12 to 15 in 0.01 mm, covered with little dots. These dots are seen only under high magnifying powers. Diameter of the valves from 0.01 to 0.113 mm. *Cyclotella baikalensis* is a variable species and seems to comprise several different forms. The following are distinguished by me:

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. TYPICA fo. nov. Plate 2, figs. 6, 7, and 20.

Valves with outer striated rim not marked in the middle with short dark dashes or lines. Central dots small or large. Diameter of the valve, 0.05 to 0.013 mm. Striæ 12 to 15 in 0.01 mm. Very common.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. STELLATA fo. nov. Plate 3, figs. 1, 4, and 5.

Differs from the type in having irregular and elongate dots around the central dotted area. Valves larger than in form *typica*. Striæ 12 in 0.01 mm. Uncommon.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. ORNATA fo. nov. Plate 2, figs. 4, 8, 9, 11 to 13, and 16.

The outer rim in the middle part of radiating striæ, marked with short dark dashes or lines, forming a second disk. Diameter of the valve, 0.03 to 0.08 mm. Striæ 11 to 12 in 0.01 mm. Abundant in Baikal.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. MINUTA fo. nov. Plate 2, figs. 10, 14, and 15.

Valve minute, about 0.01 to 0.02 mm in diameter; radiating striæ 10 to 12 in 0.01 mm. Very common. *Cyclotella baikalensis* is a distinct species related to *C. stylorum* Brightwell, known from the seashores of tropical and northern districts, and to *C. striata* (Kütz.) Grun., reported largely from sea water and from the brackish water from the mouths of rivers.

STEPHANODISCUS HANTZSCHII Grun. Plate 2, figs. 1, 2, and 5.

Stephanodiscus Hantzschii Grun., FR. HUSTEDT, Bacillar. (1930) 110, fig. 87.

Valve minute, slightly siliceous, circular, 0.0085 to 0.01 mm in diameter. The discus rim with one row of fine spines. Outer area with radiating rows of fine beads, 10 to 12 in 0.01 mm, with puncta 16 to 18 in 0.01 mm. Central area small, sparsely punctate with irregular dots. Very common.

STEPHANODISCUS ASTRÆA (Ehr.) Grun. var. MINUTULA (Kütz.) Grun. Plate 2, fig. 3.

Stephanodiscus astræa (Ehr.) Grun. var. *minutula* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 110, fig. 86.

Valve circular with surface separated into two areas. The inner part sparsely punctate with irregular dots and the outer area covered with radiating double rows of beads. Marginal spines indistinct. Diameter, 0.012 mm. Striæ 6 in 0.01 mm. Rare.

COSCINODISCUS RADIATUS Ehrenb. Plate 2, figs. 17 and 18.

Coscinodiscus radiatus Ehrenb., A. SCHMIDT, Atlas Diatom. (1878) pl. 60, figs. 1–6, 9, 10; pl. 61, fig. 13.

Valve circular, about 0.056 to 0.07 mm in diameter, covered with large areoles of about equal size, in the middle part 4 to 5 in 0.01 mm, near the margin 7 in 0.01 mm. Marginal rim densely beaded, forming radiating rows of beads. A distinct species known from all seas. Very common in the Caspian Sea. Several frustules were observed in the Olhon Gate sample.

TETRACYCLUS LACUSTRIS Ralfs. Plate 4, fig. 12.

Tetracyclus lacustris Ralfs, FR. HUSTEDT, Bacillar. (1930) 121, fig. 95.

Frustule broad, plank-shaped in long bands. Valves in valve view elliptic to rhombic-lanceolate, narrowed towards the ends and gibbous in the middle. Length, 0.04 to 0.051 mm; breadth, 0.02 to 0.025. Transverse costæ 2, striæ 24, in 0.01 mm. Very common. Known from Arctic and northern alpine regions.

TABELLARIA FENESTRATA (Lyngb.) Kütz. Plate 4, fig. 7.

Tabellaria fenestrata (Lyngb.) Kütz., FR. HUSTEDT, Bacillar. (1930) 122, fig. 99.

Valve linear with capitate ends and gibbous middle part. Length, 0.037 mm; breadth, 0.0076. Very rare. Common in European lakes.

OPEPHORA MARTYI Heribaud. Plate 4, fig. 16; Plate 5, fig. 56.

Fragilaria mutabilis Grun. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 7, pl. 1, fig. 9.

Frustule cone-shaped with broad ends. Valve elongate-oval. Length, 0.025 to 0.049 mm; breadth, 0.0068 to 0.0085. Costæ robust, 4 to 8 in 0.01 mm. Common. Known from the bottoms of many lakes.

OPEPHORA MARTYI Heribaud var. **BAIKALENSIS** var. nov. Plate 5, fig. 48.

Valve minute, narrower than the type. Length, 0.0085 to 0.017 mm; breadth, 0.0017 to 0.0034. Costæ 9 to 12 in 0.01 mm. Uncommon.

CERATONEIS ARCUS Kütz.

Ceratoneis arcus Kütz., FR. HUSTEDT, Bacillar. (1930) 134–135, fig. 122.

Valve lunate, attenuate towards the subcapitate ends. Ventral side in the middle part slightly gibbous. Length, 0.112 mm; breadth, 0.07. Striæ 15 in 0.01 mm. Rare.

FRAGILARIA PINNATA Ehr. Plate 5, fig. 49.

Fragilaria pinnata Ehr., FR. HUSTEDT, Bacillar. (1930) 142, fig. 141.

Valve elliptic with broad ends. Length, 0.0068 mm; breadth, 0.002. Striæ robust, 9 in 0.01 mm. Common.

FRAGILARIA PINNATA Ehr. var. **BAIKALENSIS** var. nov. Plate 5, fig. 55.

Differs from the type in its more robust striæ, 6 in 0.01 mm. Length, 0.012 mm; breadth, 0.005. Uncommon.

FRAGILARIA SPINOSA sp. nov. Plate 1, figs. 13 and 27; Plate 4, figs. 13 and 19; Plate 5, figs. 54 and 59.

Fragilaria mutabilis Grun. var. *robusta* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 7, pl. 1, fig. 8.

Frustules plank-shaped, joined in bands with distinct spines. Valves elliptic-lanceolate, gibbous in the middle and attenuate towards the subacute ends. Length, 0.032 to 0.051 mm; breadth, 0.01 to 0.013. Costæ 4.5 to 8.5 in 0.01 mm, not striate. Intercostal spines 6 or 7 in 0.01 mm. Median line lanceolate, gradually attenuate to the ends. A variable species of peculiar type, akin to *F. robusta* Hustedt, known as a fossil from Pensacola.[1] Common in Baikal.

FRAGILARIA LACUS BAIKALI sp. nov. Plate 13, fig. 30.

Frustules linear, connected in bands. Valve linear-lanceolate, gradually attenuate towards the subacute ends. Length, 0.068

[1] Schmidt, Atlas Diatom. (1913) pl. 297, fig. 83.

mm; breadth, 0.012. Striæ robust, almost parallel, 5 in 0.01 mm. Median area narrow and linear. A distinct species, akin to *F. spinosa* sp. nov. and to large marine *Opephora*. Infrequent.

SYNEDRA ULNA (Nitzsch) Ehr. var. DANICA (Kütz.) Grun.

Synedra ulna (Nitzsch) Ehr. var. *danica* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 154, fig. 168; A. SCHMIDT, Atlas Diatom. (1914) pl. 303, fig. 8.

Valve long, narrow-lanceolate with slightly capitate ends. Length, 0.265 to 0.272 mm; breadth, 0.0051 to 0.0052. Striæ 9 to 10 in 0.01 mm. A plankton diatom common in Baikal.

SYNEDRA ULNA (Nitzsch) Ehr. var. BICEPS (Kütz.)

Synedra ulna (Nitzsch) Ehr. var. *biceps* (Kütz.), FR. HUSTEDT, Bacillar. (1930) 154, fig. 166.

Synedra biceps Kütz., A. SCHMIDT, Atlas Diatom. (1914) pl. 303, figs. 10–15.

Valve linear-lanceolate with capitate ends. Length, 0.25 mm; breadth, 0.005. Striæ 9 in 0.01 mm. Uncommon.

SYNEDRA ULNA (Nitzsch) Ehr. var. SUBAEQUALIS Grun.

Synedra ulna (Nitzsch) Ehr. var. *subaequalis* Grun., A. SCHMIDT, Atlas Diatom. (1914) pl. 303, fig. 2.

Valve linear-lanceolate, gradually tapering from the middle to the subacute ends. Rare.

SYNEDRA ACUS Kütz. var. RADIANS (Kütz.) Hust.

Synedra acus Kütz. var. *radians* (Kütz.) Hust., FR. HUSTEDT, Bacillar. (1930) 155, fig. 171.

Differs from the preceding form in its more robust valves. Length, 0.17 mm; breadth, 0.0035. Breadth of the ends 0.0008 mm. Striæ 12 in 0.01 mm. Uncommon.

SYNEDRA ACUS Kütz. var. ANGUSTISSIMA Grun.

Synedra acus Kütz. var. *angustissima* Grun., FR. HUSTEDT, Bacillar. (1930) 155, fig. 172.

The longest and the finest species in Baikal Lake. Valve narrow-lanceolate with slightly capitate ends. Length, 0.4 to 0.5 mm; breadth, 0.003. Breadth of the ends 0.0008 mm. Striæ 13 to 14 in 0.01 mm. A typical plankton diatom.

SYNEDRA VAUCHERIÆ Kütz. var. CAPITELLATA Grun. Plate 4, fig. 1.

Synedra Vaucheriæ Kütz. var. *capitellata* Grun., FR. HUSTEDT, Bacillar. (1930) 161, fig. 194.

Valve linear-lanceolate with inflated margins. Length, 0.022 mm; breadth, 0.0042. Striæ in the middle part interrupted from

one side of the valve, about 15 in 0.01 mm. Median line filiform. Differs from the type in its more robust striæ. Rare.

SYNEDRA RUMPENS Kütz. Plate 5, figs. 6 and 61.

Synedra rumpens Kütz., FR. HUSTEDT, Bacillar. (1930) 156, fig. 175.

Valve narrow-lanceolate with attenuate, subacute ends. The middle part of the valve from both sides slightly undulate. Length, 0.04 to 0.049 mm; breadth, 0.004. Striæ 18 to 20 in 0.01 mm. Uncommon.

EUNOTIA PRÆRUPTA Ehr. Plate 4, fig. 3.

Eunotia prærupta Ehr., FR. HUSTEDT, Bacillar. (1930) 174, fig. 211.

Valve convex on dorsal side, apices dilated and truncate. Length, 0.044 mm; breadth, 0.01. Striæ 8 to 9 in 0.01 mm. Rare.

EUNOTIA PRÆRUPTA Ehr. var. INFLATA Grun. Plate 4, figs. 10 and 11.

Eunotia prærupta Ehr. var. *inflata* Grun., FR. HUSTEDT, Bacillar. (1930) 174, fig. 212.

Differs from the type in its more inflated valves. Length, 0.042 to 0.044 mm; breadth, 0.0085 to 0.012. Striæ 7 in 0.01 mm. Rare.

EUNOTIA SUBMONODON Hustedt. Plate 4, fig. 17.

Eunotia submonodon Hustedt, A. SCHMIDT, Atlas Diatom. (1913) pl. 288, figs. 18, 18*a*.

Valve arcuate, recurved, with slightly subcapitate broad ends. Length, 0.102 mm; breadth, 0.01. Striæ irregular with marginal shorter striæ interrupted between them. Striæ 4 in 0.01 mm. Puncta 18 to 20 in 0.01 mm. Pseudonodules distinct. A distinct species, reported from Columbia River, North America, and from Povenetkoi Lake, northern Europe. Rare.

EUNOTIA CLEVEI Grun. Plate 4, fig. 8.

Eunotia Clevei Grunow, P. CLEVE, Diatoms of Finland (1891) 55, pl. 3, figs. 13–16; A. SCHMIDT, Atlas Diatom. (1913) pl. 290, figs. 1, 4.
Eunotia Clevei Grunow var. *sinica* SKVORTZOW, Alpine Diatoms from South China (1929) 40, pl. 2, figs. 2, 3; pl. 3, fig. 8.

Frustule large, broad-lanceolate with broad abrupt ends. Valve gently arcuate, with slightly protracted and rounded ends. Transverse striæ regular, forming a distinct median line, following at some distance the lower margin and ending in very distinct, downward-curved end nodules. Length, 0.12 to 0.136 mm; breadth, 0.02 to 0.025. Striæ 10 to 11, puncta 12 to 13, in 0.01 mm. A variable species in Baikal Lake. Known as a

fossil in the deposits of Lake Forarn (Asnen, Sweden), in glacial clay from Hernosand, in Lake Malaren in Sweden, in deposits from the State of Washington, North America, and in the Neogene deposits near Sendai, Nippon. Recently found in Ladoga and Onega Lakes, northern Europe, in mountains near Foochow, southern China, and very common in Baikal Lake.

EUNOTIA CLEVEI Grun. var. BAIKALENSIS var. nov. Plate 4, figs. 4 to 6.

Differs from the type in its irregularly interrupted striæ along the median line.

Length, 0.111 to 0.221 mm; breadth, 0.022 to 0.03. Striæ 10 to 11 in 0.01 mm. Very common in Baikal.

EUNOTIA CLEVEI Grun. var. HISPIDA var. nov. Plate 4, figs. 9 and 18.

Differs from the type in having distinct marginal spines and furcate projections from both sides of the frustule. Length, 0.144 to 0.16 mm; breadth, 0.023 to 0.027. Striæ 9 to 10; puncta 12 to 14 in 0.01 mm. Spines 4 to 5 in 0.01 mm. Uncommon.

EUNOTIA LACUS BAIKALI sp. nov. Plate 4, fig. 2.

Valve arcuate or lunate, not attenuate towards the ends, but abruptly rounded. Striæ irregular, interrupted, forming a distinct median line. End nodules arcuate and large. Length, 0.153 to 0.175 mm; breadth, 0.02 to 0.025. Striæ 11, puncta 5 to 8, in 0.01 mm. A peculiar species related to *E. Clevei* Grun. Uncommon.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve. Plate 5, fig. 51.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Differs from the type in its upper valve being crossed from each side by 8 to 10 broad, longitudinal, blank, undulating and zigzag bands. Length, 0.03 mm; breadth, 0.018. Striæ 24 in 0.01 mm. Common.

COCCONEIS PLACENTULA (Ehr.) var. BAIKALENSIS var. nov. Plate 5, figs. 5?, 7, and 8.

Valve elliptic-lanceolate, slightly attenuate towards the rounded ends. Length, 0.012 to 0.024 mm; breadth, 0.0068 to 0.014. Upper valve with a broad elliptic axial area. Striæ marginal, 18 in 0.01 mm, with three longitudinal bands. Lower valve with very fine striæ, about 30 in 0.01 mm. Differs from the type in its upper valve having broad-elliptic axial and central areas. Common.

COCCONEIS PLACENTULA (Ehr.) var. ROUXII Brun and Herib. Plate 5, figs. 52 and 53.

Cocconeis placentula (Ehr.) var. *Rouxii* Brun and Heribaud, J. HERIBAUD, Diatomees d'Auvergne (1893) 45, pl. 1, fig. 3.

Valve elliptic with rounded ends. Length, 0.023 to 0.029 mm; breadth, 0.0136 to 0.017. Upper valve with striæ 13 in 0.01 mm. Puncta 15 in 0.01 mm. Lower valve with striæ 12 to 13, and puncta 15, in 0.01 mm. Differs from the type in its more robust striæ. Common in Baikal. Reported from France as fossil (Auvergne) and recent, and from Onega Lake, northern Europe.

COCCONEIS DIMINUTA Pant. Plate 5, figs. 38 and 39.

Cocconeis diminuta Pant., FR. HUSTEDT, Bacillar. (1930) 190–191, fig. 265.

Valve elliptic with broad rounded ends. Length, 0.0085 mm; breadth, 0.006. Upper valve with robust subradiate striæ, 24 in 0.01 mm. Median line narrow. Lower value with fine radiate striæ, 35 in 0.01 mm. Differs from the type in its coarser striæ of the upper valve. Rare.

EUCOCCONEIS BAIKALENSIS sp. nov. Plate 5, figs. 24, 41, 44, 50, 57, and 58.

Valve linear-lanceolate with broad, somewhat parallel margins and abruptly attenuate, subtruncate ends. Length, 0.03 to 0.073 mm; breadth, 0.015 to 0.0185. Upper valve with oblique, linear axial area, on one side of which in the middle part of the valve there is a horseshoe area. Striæ robust, slightly radiate, 10 to 12 in 0.01 mm, finely punctate. Lower valve with narrow, linear, axial area and strongly radiate, punctate striæ, 11 to 13 in 0.01 mm. Puncta 18 in 0.01 mm. Striæ forming in the central area a broad stauros, truncate outward. The middle striæ alternately longer and shorter. A large and distinct species.

EUCOCCONEIS ONEGENSIS Wisl. and Kolbe. Plate 5, figs. 63 and 66.

Eucocconeis onegensis WISLOUCH and KOLBE, New diatoms from Russia (1916) Journ. Microbiologie 3: 269–271, pl. 3, fig. 5–6; Beiträge zur Diatomeenflora des Onega-sees (1927) 33, 72, pl. figs. 2, 3; SKVORTZOW, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 6, figs. 4, 5.

Valve lanceolate, broad-undulate at the middle, gradually attenuate towards the ends. Length, 0.022 mm; breadth, 0.012. Upper valve with oblique axial area. Central area dilated, irregularly larger on one side of the valve than on the other.

Lower valve with narrow axial area and narrow stauros, widened and truncate outward. Striæ of the upper and lower valves 18 in 0.01 mm, punctate. Puncta about 24 in 0.01 mm. Rare. Known from Onega Lake, northern Europe, and from Biwa Lake, Nippon.

ACHNANTHES LACUS BAIKALI sp. nov. Plate 5, figs. 16 and 27.

Valve broad elliptic-lanceolate with somewhat attenuate ends. Length, 0.015 mm; breadth, 0.009. Upper valve with narrow, lanceolate axial and central areas. Striæ radiate, not lineate, 9 in 0.01 mm. Lower valve also with narrow axial and central areas and more distinct puncta. Striæ 7 to 8 in 0.01 mm. A distinct species which shows a relation to *A. delicatula* Kütz.[2]

ACHNANTHES PROFUNDA sp. nov. Plate 5, figs. 3, 26, 31, and 37.

Valve elliptic with broad rounded ends. Length, 0.015 to 0.029 mm; breadth, 0.01. Upper valve with lanceolate, narrow axial area. Striæ robust, radiate, 6 in 0.01 mm. Striæ with double rows of puncta. Puncta 24 in 0.01 mm. Lower valve with lanceolate axial and central areas. Striæ radiate, 11 in 0.01 mm, distinctly lineate. Common.

ACHNANTHES MEYERI sp. nov. Plate 5, figs. 1, 2, 22, and 23.

Valve rhombic-lanceolate with short acute ends. Length, 0.01 to 0.018 mm; breadth, 0.0068 to 0.014. Upper valve with robust, radiate costæ, 10 to 11 in 0.01 mm and a horseshoe-shaped area on one side of the valve. Axial and central areas narrow-linear. Lower valve with fine radiate striæ, about 24 in 0.01 mm. Axial area narrow; central area slightly dilated. Near the margin a distinct longitudinal stria from each side of the valve. This species is related to *A. Oestrupii* (A. Cleve) Hustedt. Named in honor of Prof. K. I. Meyer, who has collected this form in Baikal.

ACHNANTHES STRIATA Skv. and Meyer. Plate 5, figs. 11, 12, and 45 to 47.

Achnanthes striata SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 23.

Valve elliptic-lanceolate, attenuate towards the acute ends. Length, 0.015 to 0.03 mm; breadth, 0.008 to 0.009. Upper valve with robust and radiate striæ, 9 in 0.01 mm, distinctly punctate. Axial and central areas narrow. Lower valve with radiate striæ, 12 in 0.01 mm, alternately longer and shorter. Axial and central areas broad-lanceolate. Median line filiform. This is a distinct species akin to *A. Clevei* Grun., from which it dif-

[2] Hustedt, Bacillar. (1930) 202, fig. 293.

fers in its nonpunctate striæ of the lower part of the valve. Very common.

ACHNANTHES HASTATA Skv. and Meyer. Plate 5, figs. 32 and 33.

Achnanthes hastata SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 22.

Valve lanceolate with narrow acute ends. Length, 0.022 to 0.035 mm; breadth, 0.0085. Upper valve with narrow, linear, axial and central areas, and with parallel striæ slightly radiate to the ends, 10 in 0.01 mm. Striæ not lineate. Lower valve also with narrow axial and central areas. Striæ parallel, 10 to 11 in 0.01 mm, slightly radiate at the ends and fine-punctate. The middle striæ more distinct. Uncommon.

ACHNANTHES EXIGUA Grun. var. BAIKALENSIS var. nov. Plate 5, figs. 29, 30, 42, and 43.

Valve elliptic with rostrate ends. Length, 0.01 to 0.0136 mm; breadth, 0.005. Upper valve with fine, radiate striæ, 15 to 20 in 0.01 mm, more distinct in the middle part. Axial and central areas narrow-lanceolate. Lower valve with narrow axial and central areas. Striæ radiate, 15 to 20 in 0.01 mm. The lower valve differs from that of the type in its narrow central area and its more robust striæ. Uncommon.

ACHNANTHES CLEVEI Grun. var. ROSTRATA Hustedt. Plate 5, figs. 21 and 36.

Achnanthes Clevei Grun. var. *rostrata* HUSTEDT, Bacillar. (1930) 204, fig. 295.

Valve lanceolate with rostrate ends. Length, 0.012 mm; breadth, 0.005. Upper valve with linear axial area and robust, radiate costæ, 12 in 0.01 mm. Intermediate spaces distinctly punctate. Lower valve with very narrow axial area and small orbicular central area. Striæ radiate, 18 in 0.01 mm, distinctly punctate. Known from European lakes. Uncommon.

ACHNANTHES OESTRUPII (A. Cleve) Hustedt. Plate 5, figs. 9, 10, and 20.

Achnanthes Oestrupii (A. Cleve) Hustedt, FR. HUSTEDT, Bacillar. (1930) 207, fig. 301.

Valve broad-elliptic, attenuate towards the ends. Length, 0.02 to 0.03 mm; breadth, 0.009 to 0.015. Upper valve with radiate striæ, 10 in 0.01 mm, and on one side of the valve in the middle part with a distinct horseshoe-shaped area. Axial area narrow-lanceolate. Upper valve with fine striæ, about 24 in 0.01 mm. Axial area narrow; central area orbicular. Baikal specimens are larger than the type. Common. Known as a fossil in Europe and as a recent species in alpine lakes.

ACHNANTHES OESTRUPII (A. Cleve) Hustedt var. MINUTA var. nov. Plate 5, fig. 40.

Valve elliptic-lanceolate, attenuate towards the subrostrate ends. Length, 0.0055 mm; breadth, 0.0034. Upper valve with linear axial and central areas. Striæ radiate, fine, 28 in 0.01 mm. Lower valve with narrow axial and central areas. Striæ very fine, about 30 in 0.01 mm. Differs from the type in its smaller size and subrostrate ends. Rare.

ACHNANTHES BAIKALENSIS Skv. and Meyer. Plate 5, figs. 34 and 35.

Achnanthes baikalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 21.

Valve rhomboidal-lanceolate with acute ends. Length, 0.025 to 0.032 mm; breadth, 0.01 to 0.011. Upper valve with lanceolate axial and central areas. Striæ robust, not lineate, radiate, 7 to 8 in 0.01 mm, with a horseshoe-shaped area on one side of the valve. Lower valve with lanceolate axial area, suborbicular central area, and distinct filiform median line and radiate striæ, 8 to 9 in 0.01 mm. The median striæ more distinct than the others. This species resembles *A. lanceolata* Breb., but differs in its rhomboidal shape and more robust striæ.

ACHNANTHES LANCEOLATA Breb. Plate 5, figs. 13, 19, 25, and 28.

Achnanthes lanceolata Breb., FR. HUSTEDT, Bacillar. (1930) 207, fig. 306*a*.

Valve elliptic-lanceolate with slightly attenuate and broad rounded ends. Length, 0.015 to 0.037 mm; breadth, 0.007 to 0.0085. Upper valve with slightly radiate striæ, 10 to 12 in 0.01 mm, and a horeshoe-shaped area on one side of the valve. Axial and central areas narrow. Lower valve with radiate striæ, about 11 to 12 in 0.01 mm. Axial area narrow, central area slightly enlarged. Fairly common.

ACHNANTHES LANCEOLATA Breb. var. ROSTRATA Hustedt. Plate 5, fig. 18.

Achnanthes lanceolata Breb. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Differs from the type in its rostrate ends. Length, 0.009 mm; breadth, 0.005. Upper valve with robust striæ, about 12 in 0.01 mm, and a horseshoe-shaped area in the middle part of the valve. Rare.

ACHNANTHES LANCEOLATA Breb. var. ELLIPTICA Cleve. Plate 5, fig. 14.

Achnanthes lanceolata Breb. var. *elliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*c*.

Valve elliptic. Length, 0.0065 mm; breadth, 0.0034. Costæ 18 in 0.01 mm. Smaller than the type. Rare.

ACHNANTHES PERAGALLII Brun and Herib. Plate 5, fig. 15.

Achnanthes Peragallii Brun and Herib., FR. HUSTEDT, Bacillar. (1930) (1930) 207, fig. 300.

Valve broad-elliptic with rostrate ends. Length, 0.01 mm; breadth, 0.0048. Upper valve with slightly radiate striæ, about 18 in 0.01 mm, and with a horseshoe-shaped area in the middle part of the valve. Lower valve not seen. Smaller than the type. Common.

ACHNANTHES CALCAR Cleve. Plate 5, fig. 4.

Achnanthes calcar Cleve, FR. HUSTEDT, Bacillar. (1930) 207, fig. 305.

Valve broad-elliptic. Length, 0.01 mm; breadth, 0.0076. Upper valve with fine radiate striæ, about 25 in 0.01 mm. On one side in the middle of the valve there is a horseshoe-shaped area. The lower valve not examined. Rare. Known in fresh water and as a fossil from the *Ancylus* epoch in northern Europe.

RHOICOSPHENIA CURVATA (Kütz.) Grun. Plate 14, fig. 10.

Rhoicosphenia curvata (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 211, fig. 311.

Frustule curvate, cone-shaped. Valve clavate. Length, 0.017 mm; breadth, 0.0034. Axial area linear; central area indistinctly suborbicular. Striæ slightly radiate, 12 in 0.01 mm. Rare.

FRUSTULIA RHOMBOIDES (Ehr.) De Toni var. **AMPHIPLEUROIDES** Grun. Plate 10, fig. 8.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun., FR. HUSTEDT, Bacillar. (1930) 221, fig. 326.

Valve lanceolate with attenuate and subacute ends. Length, 0.119 mm; breadth, 0.021. Central nodule elongate, median line slightly eccentric. Rare.

GYROSIGMA SPENSERII (W. Smith) Cleve var. **NODIFERA** Grun. Plate 5, fig. 62.

Gyrosigma Spenserii (W. Smith) Cleve var. *nodifera* Grun., FR. HUSTEDT, Bacillar. (1930) 225, fig. 337.

Gyrosigma attenuatum Kütz. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 25, pl. 2, fig. 87.

Valve linear, slightly sigmoid, with obtuse ends. Length, 0.144 mm; breadth, 0.015. Central nodule surrounded by an elongate, oblique area. Middle striæ slightly radiate. Longitudinal and transverse striæ 15 in 0.01 mm. Rare.

GYROSIGMA BAIKALENSIS sp. nov. Plate 5, figs. 64 and 65.

Valve lanceolate, slightly sigmoid. Ends more or less produced, turned in contrary directions. Median line sigmoid,

central area slightly flexuose with radiate striæ. Transverse and longitudinal striæ 17 to 18 in 0.01 mm. Length, 0.178 to 0.187 mm; breadth, 0.018. A distinct species akin to *G. distorum* W. Sm. and var. *Parkeri* Harrison, reported from marine and brackish waters. Variety *Parkeri* is found also in fresh water.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. var. BAIKALENSIS var. nov. Plate 5, fig. 60.

Valve linear-lanceolate, slightly sigmoid. Length, 0.119 mm; breadth, 0.013. Transverse and longitudinal striæ 18 in 0.01 mm. Differs from the type in its narrower valves. Rare.

CALONEIS ZACHARIASI Reichelt. Plate 9, figs. 32 and 33?

Caloneis Zachariasi Reichelt, FR. HUSTEDT, Bacillar. (1930) 234, fig. 355.

Valve lanceolate, slightly undulate with subtruncate ends. Length, 0.03 to 0.052 mm; breadth, 0.009. Axial area linear; central area somewhat dilated. Median line filiform. Striæ distinctly punctate, 12 to 15 in 0.01 mm. Rare. Known from the bottoms of European lakes.

CALONEIS ZACHARIASI Reichelt var. CONSTRICTA var. nov. Plate 9, figs. 27 and 45.

Differs from the type in its constricted valve. Length, 0.022 to 0.037 mm; breadth, 0.0068 to 0.012. Striæ 15 in 0.01 mm. Rare.

CALONEIS ZACHARIASI Reichelt var. ELONGATA var. nov. Plate 8, fig. 18.

Differs from the type in having elongate valves. Length, 0.037 mm; breadth, 0.0085. Striæ slightly radiate, 15 in 0.01 mm. Puncta in distinct longitudinal striæ, 12 in 0.01 mm. Rare.

CALONEIS LATIUSCULA (Kütz.) Cleve. Plate 7, fig. 12; Plate 9, fig. 24.

Caloneis latiuscula (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 233, fig. 351.

Valve elliptic-lanceolate with slightly attenuate and rounded ends. Length, 0.064 to 0.072 mm; breadth, 0.014 to 0.02. Striæ 14 to 18 in 0.01 mm. Median line robust. Axial and central areas lanceolate. Striæ slightly divergent in the middle and at the ends, 14 in 0.01 mm. This species is known from large lakes.

CALONEIS LATIUSCULA (Kütz.) Cleve var. ROSTRATA var. nov. Plate 9, fig. 35.

Valve with subrostrate ends. Length, 0.063 mm; breadth, 0.015. Striæ 14 in 0.01 mm. Terminal fissures with a distinct pore. Differs from the type in its subrostrate ends, narrower valve, and more robust striæ. Uncommon.

CALONEIS SILICULA (Ehr.) Cleve. Plate 7, fig. 10.

Caloneis silicula (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 236, fig. 362.

Valve linear-lanceolate, slightly triundulate. Axial and central areas lanceolate, in the middle part suborbicular. Length, 0.061 mm; breadth, 0.015. Striæ 18 to 20 in 0.01 mm. Rare.

CALONEIS SILICULA (Ehr.) Cleve var. MAJOR var. nov. Plate 8, fig. 14.

Navicula Heribaudii PERAG., in Skv. and Meyer, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 43.

Valve elongate, gibbous in the middle, with clavate, obtuse ends. Length, 0.119 to 0.141 mm; breadth, 0.018 to 0.02. Axial area broad and very distinct; central area a broad transverse fascia. Striæ 14 to 16 in 0.01 mm, slightly divergent in the middle and at the ends. Differs from variety *ventricosa* (Ehr.) Donkin and variety *Kjellmaniana* Cleve in its larger size. Common in Baikal.

CALONEIS SCHUMANNIANA (Grun.) Cleve. Plate 8, fig. 29.

Caloneis Schumanniana (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 239–240, fig. 369.

Navicula Henckeli SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 53.

Valve almost linear-lanceolate, slightly inflated in the middle part and gradually attenuate towards the obtuse ends. Length, 0.047 to 0.061 mm; breadth, 0.0085 to 0.01. Striæ 15 to 16 in 0.01 mm. Axial area in the upper part indistinct, in the middle part enlarged; central area broad, with lunate markings on each side of the central nodule. Common.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. Plate 9, fig. 22.

Caloneis Schumanniana (Grun.) Cleve var. *biconstricta* Grun., FR. HUSTEDT, Bacillar. (1930) 240, fig. 370*a*, *b*.

Valve biconstricted with undulate ends. Length, 0.068 mm; breadth, 0.012. Striæ radiate, 15 in 0.01 mm, not dilated near the lunate margins. Uncommon.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. fo. BAIKALENSIS fo. nov. Plate 7, fig. 18; Plate 8, fig. 33; Plate 9, fig. 10.

Differs from variety *biconstricta* in its striæ, dilated in the middle part of the valve. Length, 0.034 to 0.068 mm; breadth, 0.0068 to 0.014. Striæ 14 to 17 in 0.01 mm. Very common.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. fo. UNDULATA fo. nov. Plate 8, fig. 16.

Caloneis undulata SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 13, pl. 1, fig. 48.

Differs from variety *baikalensis* in its more undulate valves, robust striæ, and larger valves. Length, 0.068 to 0.076 mm; breadth, 0.011 to 0.012. Striæ 14 to 17 in 0.01 mm. Our form *undulata* has nothing to do with variety *trinodis* Lewis, which it seems belongs to a distinct species. Common.

CALONEIS IGNORATA sp. nov. Plate 8, fig. 26.

Valve linear, with parallel margins, and broad rounded ends. Length, 0.045 mm; breadth, 0.0085. Axial area narrow, linear; central area elliptic. Median line filiform, with distinct terminal fissures. Striæ radiate, 12 (middle), 18 (end), in 0.01 mm. A distinct species related to *C. lepidula* (Grun.) Cleve.

CALONEIS DELICATULA sp. nov. Plate 7, fig. 29.

Valve rectangular-elliptic, with cuneate ends and slightly constricted margins. Length, 0.035 mm; breadth, 0.012. Axial area narrow, somewhat dilated in the middle; central area suborbicular. Striæ divergent in the middle and at the ends, 12 in 0.01 mm, not punctate. Median line filiform, with comma-shaped terminal fissures. No longitudinal lines along the margin. Rare.

CALONEIS SIMPLEX sp. nov. Plate 8, fig. 34.

Navicula sp. DOROGOSTAISKY, Materiaux pour servir a l'algologie du lac Baikal et de son bassin, Bull. de Moscou Nat. Hist. Soc. (1904) 253, pl. 6, fig. 8.

Valve constricted, lanceolate with attenuate ends. Length, 0.052 to 0.06 mm; breadth, 0.660 (middle), fissures 0.012 (ends). Median line filiform, with comma-shaped fissures. Axial area narrow; central area a broad fascia. Striæ radiate, 7 to 10 in 0.01 mm, robust, not lineate. No longitudinal lines near the margin. Akin to *C. nipponica* Skv. from Biwa Lake, Nippon.

CALONEIS RELICTA sp. nov. Plate 7, fig. 14; Plate 8, fig. 20.

Valve lanceolate with subrostrate ends. Length, 0.039 to 0.052 mm; breadth, 0.015 to 0.017. Median line straight with little, comma-shaped, terminal fissures and distinct central pores. Axial area narrow; central area slightly dilated. Striæ radiate throughout, 8 in 0.01 mm, not lineate, crossed from both sides of the median line by two, longitudinal, undulating bands, forming something like a blank area. A distinct species.

NEIDIUM DILATATUM (Ehr.) Cleve. Plate 8, fig. 15.

Neidium dilatatum (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 385.

Valve broad elliptic-lanceolate with cuneate ends. Length, 0.059 mm; breadth, 0.024. Axial area narrow; central area

orbicular. Striæ fine, about 20 in 0.01 mm. On both sides of the valve near the margin are several, distinct, longitudinal lines. A north-alpine species, reported from the northern part of Europe.

NEIDIUM DILATATUM (Ehr.) Cleve fo. **CURTA** fo. nov. Plate 7, fig. 33.

Valve broad elliptic-lanceolate with cuneate ends. Length, 0.034 mm; breadth, 0.017. Striæ radiate, 17 to 18 in 0.01 mm. Puncta 24 in 0.01 mm. Smaller and broader than the type.

NEIDIUM DUBIUM (Ehr.) Cleve. Plate 9, fig. 41.

Neidium dubium (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 384*a*.

Valve elliptic with obtuse nonrostrate ends. Length, 0.031 mm; breadth, 0.012. Axial area narrow; central area orbicular. Striæ fine, 18 in 0.01 mm. Differs from the type in its subrostrate ends.

NEIDIUM DUBIUM (Ehr.) Cleve fo. **CONSTRICTA** Hust. Plate 8, fig. 23.

Neidium dubium Ehr. var. *constricta* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 13, pl. 1, fig. 35.

Valve slightly constricted, ends subrostrate. Length, 0.034 to 0.04 mm; breadth, 0.01 to 0.013. Striæ radiate, 18 to 20 in 0.01 mm. Rare.

NEIDIUM DUBIUM (Ehr.) Cleve var. **BAIKALENSIS** var. nov. Plate 7, fig. 7.

Differs from form *constricta* Hustedt in its more elongate valves and the striæ, divided from each side of the valve into three longitudinal parts; namely, the marginal, the middle, and the central. The former has indistinct striæ. Axial and central areas narrow. Infrequent.

NEIDIUM IRIDIS (Ehr.) Cleve var. **BAIKALENSIS** var. nov. Plate 10, fig. 4.

Differs from the type in its short-lanceolate valves, with acute ends. Length, 0.078 mm; breadth, 0.03. Striæ robust, 15 in 0.01 mm. Puncta 18 in 0.01 mm. Differs from form *hercynica* (A. Mayer) Hust. in its more acute ends.

NEIDIUM LANCEOLATA sp. nov. Plate 10, fig. 3.

Valve broad-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.078 mm; breadth, 0.025. Striæ almost parallel, divergent at the ends, 11 to 12 in 0.01 mm. Puncta slightly elongate, 9 in 0.01 mm. Median line straight, enlarged in the middle with straight central pores without comma-shaped fissures, but with middle stria. Central area small, orbicular. A distinct species.

NEIDIUM LACUS BAIKALI sp. nov. Plate 7, fig. 31; Plate 18, fig. 3.

Valve linear-lanceolate, narrowed towards the subacute ends. Axial area narrow-lanceolate, somewhat dilated in its median part; central area suborbicular, with slightly eccentric median line. Median line filiform, somewhat enlarged in the middle part. Terminal fissures comma-shaped. Striæ in transverse and longitudinal rows of puncta. Transverse striæ 12 to 13, longitudinal 7, in 0.01 mm. Puncta 4 to 5 in 0.01 mm. Our figure represents a valve with the system of longest and transverse striæ. Puncta not figured. A robust species of peculiar form. Differs from *N. affine* (Ehr.) Cleve in its more robust striæ and its longitudinal lines covering the entire surface of the valve. A species closely related to *Navicula Kellerii* Pantocsek, known as a marine fossil from Hungary, Europe.[3]

DIPLONEIS OVALIS (Hilse) Cleve. Plate 6, fig. 13.

Diploneis ovalis (Hilse) Cleve, P. CLEVE, Diatoms of Finland (1891) pl. 2, fig. 13.

Valve elliptic-linear with obtuse ends. Length, 0.044 mm; breadth, 0.022. Furrows very narrow, following the central nodule. Central area enlarged. Striæ 9 in 0.01 mm. Rare.

DIPLONEIS OVALIS (Hilse) Cleve var. **NIPPONICA** Skv. Plate 6, fig. 16.

Diploneis ovalis (Hilse) Cleve var. *nipponica* SKVORTZOW, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 4, fig. 11.

Valve elliptic not lineate with obtuse ends. Length, 0.12 mm; breadth, 0.051. Median line straight; central nodule quadrate, furrow narrow, closely following the central nodule. Transverse rows of alveoli 7 to 8 in 0.01 mm. Differs from variety *oblongella* (Naeg.) Cleve in its elliptic valves and larger size.

DIPLONEIS DOMBLITTENSIS (Grun.) Cleve. Plate 6, fig. 3.

Diploneis domlittensis (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250–251, fig. 397.

Valve elliptic with broad ends. Length, 0.017 mm; breadth, 0.01. Furrows distinct, lanceolate with alveoli. Central area quadrate. Transverse rows of alveoli radiate, 9 in 0.01 mm. Alveoli very distinct, 3 to 4 in 0.01 mm. Smaller than the type. *Diploneis domblittensis* is a bottom diatom from European lakes.

DIPLONEIS DOMBLITTENSIS (Grun.) Cleve var. **BAIKALENSIS** var. nov. Plate 6, figs. 7, 15.

Differs from the type in its lanceolate-rhomboidal valves with obtuse ends. Length, 0.035 to 0.042 mm; breadth, 0.02. Fur-

[3] Beiträge zur Kenntniss der fossilen Bacillarien Ungarns 2: 49, pl. 23, fig. 351.

rows broad-elliptic, closely following the central nodule. Central area suborbicular. Transverse rows of alveoli radiate, 6 to 8 in 0.01 mm. Alveoli 9 to 12, sometimes forming irregular, longitudinal rows. Common.

DIPLONEIS MEYERI sp. nov. Plate 6, fig. 11; Plate 10, fig. 10.

Diploneis elliptica Cleve var. *grosse-punctata* PANTOCSEK, in Skv. and Meyer, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1, fig. 27.

Valve elliptic with obtuse ends. Length, 0.064 to 0.093 mm; breadth, 0.032 to 0.045. Median line filiform. Furrows narrow, hyaline or with alveoli by two in each row. Central area orbicular, small. Transverse rows of alveoli radiate, 4.5 in 0.01 mm, with very large and robust alveoli, about 3 in 0.01 mm. This new species is connected with *D. domblittensis* Grun. known from fresh and brackish waters of northern Europe, and in Domblitton fossils, Gulf of Bothnia; common in the Baltic deposits of the *Ancylus* epoch.

DIPLONEIS PUELLA (Schum.) Cleve. Plate 6, fig. 1.

Diploneis puella (Schum.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptic with rounded ends. Length, 0.015 mm; breadth, 0.0035. Furrows narrow. Central area quadrate. Striæ radiate, 11 to 12 in 0.01 mm. Alveoli indistinct. Rare.

DIPLONEIS PUELLA (Schum.) Cleve var. BAIKALENSIS var. nov. Plate 6, fig. 19.

Differs from the type in its rhomboidal-lanceolate valves. Length, 0.022 mm; breadth, 0.01. Striæ radiate, 9 to 10 in 0.01 mm. Alveoli indistinct. Rare.

DIPLONEIS BOLDTIANA Cleve var. BAIKALENSIS var. nov. Plate 6, fig. 8.

Differs from the type in its more elongate valve and more robust striæ. Length, 0.039 mm; breadth, 0.01. Transverse rows of alveoli radiate, 10 to 11 in 0.01 mm. Alveoli indistinct. *Diploneis Boldtiana* Cleve is known from Viado, Finland.[4]

DIPLONEIS ELLIPTICA Cleve var. LADOGENSIS Cleve. Plate 6, fig. 4.

Diploneis elliptica Cleve var. *ladogensis* Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 396.

Valve rhomboidal with obtuse ends. Length, 0.081 mm; breadth, 0.041. Furrows lanceolate, narrow with alveoli in transverse rows. Central area almost quadrate. Transverse rows of alveoli radiate, 8 in 0.01 mm, forming irregular, longi-

[4] Cleve, The diatoms of Finland (1891) 43–44, pl. 2, fig. 12.

tudinal rows. Differs from variety *ladogensis* in its furrows having two or three alveoli.

DIPLONEIS MARGINESTRIATA Hustedt var. NIPPONICA Skv. Plate 6, fig. 5.

Diploneis marginestriata Hustedt var. *nipponica* SKVORTZOW, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 4, fig. 3.

Valve linear-elliptic with cuneate ends. Length, 0.022 mm; breadth, 0.0085. Furrows broad-elliptic, with distinct rows. Central area quadrate; striæ radiate. Differs from the type in its more robust striæ and in the presence of rows on the furrows. This variety is reported from Biwa Lake, Nippon. Common.

DIPLONEIS SUBOVALIS Cleve var. BAIKALENSIS var. nov. Plate 6, fig. 14.

Valve broad-elliptic with rounded ends. Length, 0.039 mm; breadth, 0.025. Furrows broad, central area suborbicular. Median line broad, robust. Transverse rows of alveoli 5 in 0.01 mm. Costæ with double rows of alveoli, 9 to 10 in 0.01 mm, forming irregular longitudinal rows. Differs from the type in its broader valve, more robust costæ, and more distinct alveoli. *Diploneis subovalis* Cleve is known from fresh waters of Paeroa, New Zealand.[5] A related species, *D. pseudoövalis* Hustedt, is known from brackish waters. Common.

DIPLONEIS BAIKALENSIS Skv. and Meyer. Plate 6, figs. 2 and 18.

Diploneis baikalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1, fig. 31.

Valve elliptic with cuneate ends. Length, 0.064 to 0.111 mm; breadth, 0.039 to 0.056. Median line robust. Furrows broad lanceolate-elliptic, with indistinct furrow rows. Central rows with one row of puncta, the middle rows with double rows of puncta, and the end rows with one row of puncta. Central area almost quadrate. Transverse striæ radiate, 4.5 to 7 in 0.01 mm. Common.

DIPLONEIS TURGIDA sp. nov. Plate 6, fig. 9.

Valve elliptic with obtuse ends. Length, 0.059 to 0.073 mm; breadth, 0.025 to 0.032. Median line filiform. Furrows broad-lanceolate, slightly undulate at the middle, with distinct rows of large alveoli. Central area small and orbicular. Transverse rows of alveoli distinct, 5 to 6 in 0.01 mm, forming irregular longitudinal rows. Common.

[5] Cleve, Synopsis of naviculoid diatoms (1894) 1, 96, pl. 1, fig. 27.

DIPLONEIS TURGIDA sp. nov. var. **BIPUNCTATA** var. nov. Plate 6, fig. 10.

Differs from the type in having furrows with double rows of puncta. Length, 0.054 mm; breadth, 0.025. Striæ 6 in 0.01 mm. Alveoli 4.5 in 0.01 mm. Common.

DIPLONEIS LATA sp. nov. Plate 6, fig. 17.

Diploneis elliptica Cleve var. *baikalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1, fig. 29.

Valve broad-oval or broad-elliptic with obtuse ends. Length, 0.081 to 0.088 mm; breadth, 0.052 to 0.066. Median line short and broad. Furrow robust and broad, closely following the central nodule. Furrow rows covered with large alveoli. Central area suborbicular. Transverse rows of alveoli radiate, 4 in 0.01 mm. Alveoli 4 to 8 in 0.01 mm. Transverse rows of alveoli irregularly anostomosing with a few longitudinal undulating costæ. This is a distinct species, remarkable not only for the broad furrow and large alveoli, but also for its large broad-oval valve.

DIPLONEIS LATA sp. nov. var. **PUNCTATA** var. nov. Plate 6, fig. 6.

Differs from the type in its punctate central area and in its furrows without alveoli. Length, 0.068 mm; breadth, 0.045. Transverse rows of alveoli 5 in 0.01 mm. Alveoli 5 in 0.01 mm. Common.

DIPLONEIS LATA sp. nov. var. **MINUTA** var. nov. Plate 6, fig. 12.

Diploneis Mauleri Brun var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1, fig. 33.

Differs from the type in its small valves, lanceolate furrows, and distinct alveoli. Length, 0.03 mm; breadth, 0.02. Transverse rows of alveoli 4 in 0.01 mm. Very common.

STAURONEIS PHŒNICENTERON Ehr. Plate 9, fig. 49.

Stauroneis phœnicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.107 to 0.196 mm; breadth, 0.02 to 0.035. Striæ radiate, 13 in 0.01 mm. Rare.

STAURONEIS ANCEPS Ehr. var. **BAIKALENSIS** var. nov. Plate 7, fig. 17.

Valve lanceolate, subacute. Length, 0.072 mm; breadth, 0.013. Axial area narrow; central area a broad stauros. Striæ radiate, 13 to 14 in 0.01 mm. Puncta 20 to 22 in 0.01 mm. Differs from the variety *hyalina* Brun and Perag. in its unshortened median striæ. Rare.

STAURONEIS BAIKALENSIS sp. nov. Plate 7, fig. 1.

Valve elliptic-lanceolate with subrostrate ends. Length, 0.073 mm; breadth, 0.02. Median line filiform with small, comma-shaped, terminal fissures. Axial area narrow-linear; central area widened and dilated. Striæ curvate and radiate, punctate, 12 in 0.01 mm. Rare.

Genus NAVICULA Bory

NAVICULÆ ORTHOSTICHÆ CLEVE

NAVICULA CUSPIDATA Kütz. Plate 7, fig. 3.

Navicula cuspidata Kütz., FR. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Valve rhombic-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.156 mm; breadth, 0.03. Axial and central areas linear and narrow. Striæ 15 in 0.01 mm. Rare.

NAVICULÆ MESOLEIÆ CLEVE

NAVICULA ARGUENS sp. nov. Plate 7, fig. 28.

Valve lanceolate with attenuate ends. Length, 0.017 mm; breadth, 0.0042. Median line with indistinct terminal fissures. Central nodules distinct. Axial and central areas narrow-lanceolate. Striæ radiate, not lineate, 12 in 0.01 mm. This small diatom seems to be a distinct species, closely related to *N. Hustedtii* Krasske, *N. disjuncta* Hustedt, and others.

NAVICULA CONFERVACEA Kütz. var. BAIKALENSIS var. nov. Plate 7, fig. 6.

Valve elliptic lanceolate with broad rounded ends. Length, 0.018 mm; breadth, 0.0076. Axial and central areas narrow-lanceolate. Striæ slightly radiate, 25 in 0.01 mm, finely punctate. Differs from the type in its axial and central areas and finely punctate striæ. The type is known from tropical regions.

NAVICULÆ BACILLARES CLEVE

NAVICULA AMERICANA Ehr. Plate 10, fig. 1.

Navicula americana Ehr., FR. HUSTEDT, Bacillar. (1930) 280, fig. 464.

Valve elliptic with cuneate ends. Length, 0.054 mm; breadth, 0.018. Striæ radiate, 11 (middle), or 15 (ends), in 0.01 mm. Rare. Common in fresh waters.

NAVICULA BACILLUM Ehr. Plate 8, fig. 37; Plate 9, fig. 16.

Navicula bacillum Ehr., FR. HUSTEDT, Bacillar. (1930) 280, fig. 465*a*.

Valve linear-elliptic with broad ends. Length, 0.042 to 0.057 mm; breadth, 0.015 to 0.02. Median line in a thick siliceous rib. Striæ 12 (middle), or 15 to 17 (ends), in 0.01 mm. Very common.

NAVICULA PUPULA Kütz. var. CAPITATA Hust. Plate 8, fig. 22.

Navicula pupula Kütz. var. *capitata* Hust., FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*c*.

Valve lanceolate with capitate ends. Length, 0.03 mm; breadth, 0.0068. Striæ radiate, 22 (middle), or 26 to 28 (ends), in 0.01 mm. Central area quadrate. Rare.

NAVICULA PUPULA Kütz. var. BAIKALENSIS var. nov. Plate 8, fig. 21.

Valve linear-lanceolate, attenuate towards the obtuse ends. Length, 0.044 mm; breadth, 0.0068. Striæ radiate, 15 (middle) or 20 (ends), in 0.01 mm. Differs from the type in its more robust and broader valve, from variety *rectangularis* (Greg.) Grun. in its more lanceolate valve.

NAVICULA SUBHAMULATA Grun. var. PARALLELA Skv. Plate 9, fig. 37.

Navicula subhamulata Grun. var. *parallela* SKVORTZOW, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 5, fig. 11.

Valve broad-linear with parallel margins and broad rounded ends. Length, 0.016 mm; breadth, 0.005. Striæ in the middle more distinct, 21 in 0.01 mm. Median line straight. Uncommon. Reported from Biwa Lake, Nippon.

NAVICULA SUBHAMULATA Grun. var. GIBBOSA var. nov. Plate 7, fig. 2.

Differs from the type in its slightly undulate middle part. Length, 0.018 mm; breadth, 0.005. Striæ more distinct in the middle, 21 in 0.01 mm. Variety *undulata* Hust. differs from variety *gibbosa* in its triundulate valves.

NAVICULÆ DECIPIENTES CLEVE

NAVICULA FLUENS Hust. var. BAIKALENSIS var. nov. Plate 9, fig. 34.

Valve elliptic-lanceolate with attenuate, obtuse ends. Length, 0.017 mm; breadth, 0.005. Axial and central areas narrow-linear. Striæ slightly radiate, 18 to 19 in 0.01 mm, not punctate. Differs from the type in its more robust striæ. The type is known from Holstein, Germany.[6]

NAVICULA FLUENS Hust. var. SUBROSTRATA var. nov. Plate 9, fig. 5.

Valve lanceolate-elliptic with subrostrate ends. Length, 0.017 mm; breadth, 0.005. Striæ slightly radiate, 15 in 0.01 mm, in the middle part not shorter. Median line robust and distinct.

NAVICULA CRUCICULA (W. Smith) Donkin var. OBTUSATA Grun. Plate 9, fig. 25.

Navicula crucicula (W. Smith) Donkin var. *obtusata* Grun., CLEVE, and GRUNOW, Beiträge zur Kenntniss der Arctischen Diatomeen (1880) pl. 2, fig. 37.

[6] Hustedt, Bacillar. (1930) 285, fig. 474.

Valve broad-lanceolate with attenuate and broad rounded ends. Length, 0.03 mm; breadth, 0.007. Striæ radiate, 14 (middle) or 18 (ends), in 0.01 mm. Axial and central areas narrow. Known in brackish water. Uncommon.

NAVICULA SILICEA sp. nov. Plate 9, fig. 39.

Valve slightly siliceous, lanceolate with attenuate and capitate ends. Length, 0.019 mm; breadth, 0.0036. Median line filiform. Axial and central areas and striæ indistinct. This species is akin to *N. subtilissima* Cleve.

NAVICULÆ MINUSCULÆ CLEVE

NAVICULA DELICATULA sp. nov. Plate 7, fig. 15; Plate 9, fig. 19.

Valve linear-lanceolate, slightly gibbous in the middle and gradually attenuate towards the ends. Length, 0.025 to 0.026 mm; breadth, 0.005 to 0.006. Axial and central areas linear, narrow. Striæ slightly radiate, more distinct in the middle, 20 to 22 (middle), or 28 (end), in 0.01 mm. Terminal fissures distinct. This little diatom is akin to *N. densestriata* Hust.[7]

NAVICULÆ MINUSCULÆ CLEVE

NAVICULA ATOMUS (Naegeli) Grun. Plate 9, fig. 17.

Navicula atomus (Naegeli) Grun., FR. HUSTEDT, Bacillar. (1930) 288, fig. 484.

Valve minute, elliptic with broad ends. Length, 0.0085 mm; breadth, 0.0034. Striæ slightly radiate, 22 in 0.01 mm. Axial and central areas very narrow. Striæ more robust than in the type. Rare.

NAVICULÆ HETEROSTICHÆ CLEVE

NAVICULA ANTIQUA sp. nov. Plate 10, fig. 5.

Valve elliptic-lanceolate with slightly attenuate and broad rounded ends. Length, 0.119 mm; breadth, 0.03. Median line robust, filiform, with indistinct terminal fissures. Central pores with short straight projections. Axial area narrow, with a distinct, broad, terminal nodule or area; central area slightly enlarged. Striæ radiate, curved, 18 in 0.01 mm, from both sides of the valve, alternately longer and shorter. Striæ punctate. Puncta 18 to 20 in 0.01 mm. A distinct species akin to *N. maeandrinoides* Hust., from Columbia River, North America. A fresh-water fossil.[8]

[7] Hustedt, op. cit. 288, fig. 485.
[8] Schmidt, Atlas Diatom. (1930) pl. 370, fig. 3.

NAVICULA CINGENS sp. nov. Plate 8, fig. 24.

Valve broad elliptic-lanceolate. Length, 0.047 mm; breadth, 0.025. Median line filiform, robust, with indistinct terminal fissures. Axial area linear; central area elliptic. Striæ strongly radiate, punctate, 17 in the middle, 22 at the ends, in 0.01 mm. Puncta 25 to 30 in 0.01 mm. From both sides of the valve the marginal striæ are interrupted by an irregular longitudinal line. This species is related to *N. antiqua* sp. nov.

NAVICULÆ LINEALATÆ CLEVE

NAVICULA COSTULATA Grun. Plate 9, fig. 11.

Navicula costulata Grun., FR. HUSTEDT, Bacillar. (1930) 298, fig. 505.

Valve rhombic-lanceolate with subacute ends. Length, 0.023 mm; breadth, 0.005. Striæ radiate throughout, 6 in 0.01 mm. This species is known from European lakes.

NAVICULA COSTULATA Grun. var. **BAIKALENSIS** var. nov. Plate 7, fig. 4.

Differs from the type in its broad rhombic valves. Length, 0.019 mm; breadth, 0.0085. Striæ 9 in 0.01 mm, lineate. Rare.

NAVICULA COSTULOIDES sp. nov. Plate 7, fig. 22.

Valve lanceolate with attenuate ends. Length, 0.037 mm; breadth, 0.009. Striæ radiate, not lineate, divergent at the middle and convergent at the ends, more robust in the middle, 6 (middle) or 9 (ends) in 0.01 mm. Median line filiform with comma-shaped terminal fissures and distinct central nodules. Axial area narrow, central area broad. A distinct species that agrees with *N. cincta* (Ehr.) Kütz.

NAVICULA CRYPTOCEPHALA Kütz. Plate 9, figs. 7 and 15.

Navicula cryptocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with attenuate ends. Length, 0.0187 to 0.025 mm; breadth, 0.0058 to 0.0068. Striæ radiate and slightly convex at the ends, 14 to 15 in 0.01 mm. Common.

NAVICULA CRYPTOCEPHALA Kütz. var. **EXILIS** (Kütz.) Grun. Plate 7, fig. 25.

Navicula cryptocephala Kütz. var. *exilis* (Kütz.) Grun., FR. HUSTEDT, Synopsis (1880–81) 85, pl. 8, fig. 2.

Valve slightly elongate. Length, 0.021 mm; breadth, 0.005. Striæ about 20 in 0.01 mm. Our specimens are somewhat longer than the type. Rare.

NAVICULA CRYPTOCEPHALA Kütz. var. **VENETA** (Kütz.) Grun. Plate 9, fig. 9.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*a*.

Valve lanceolate with short attenuate ends. Length, 0.015 mm; breadth, 0.0043. Striæ radiate, 15 in 0.01 mm. Rare.

NAVICULA RHYNCHOCEPHALA Kütz. Plate 8, fig. 6.

Navicula rhynchocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 296, fig. 501.

Valve lanceolate with attenuate and long ends. Length, 0.047 mm; breadth, 0.009. Median line filiform. Axial area narrow, central area broad. Striæ radiate throughout, lineate, 10 in 0.01 mm. Middle striæ more distinct. Uncommon. Known in fresh and brackish waters.

NAVICULA RHYNCHOPHALA Kütz. var. **TENUA** Skv. Plate 9, figs. 12 and 48.

Navicula rhynchocephala Kütz. var. *tenua* SKVORTZOW, Diatoms from Chengtu, Szechwan, West China. pl. 3, fig. 12; pl. 4, fig. 14.

Valve lanceolate with long ends. Length, 0.023 to 0.029 mm; breadth, 0.006 to 0.0068. Striæ 15 in 0.01 mm. Known from Chentu, western China.

NAVICULA LANCEOLATA (Agardh) Kütz. Plate 7, fig. 20.

Navicula lanceolata (Agardh) Kütz., FR. HUSTEDT, Bacillar. (1930) 305, fig. 540.

Valve lanceolate, gradually attenuate towards the ends. Length, 0.034 mm; breadth, 0.0068. Striæ radiate, lineate, 12 in 0.01 mm. Common.

NAVICULA LANCEOLATA (Agardh) Kütz. var. **CYMBULA** (Donkin) Cleve. Plate 9, fig. 38.

Navicula cymbula Donkin, VAN HEURCK, Synopsis (1880–81) pl. 7, fig. 32.

Differs from the type in its more robust striæ. Length, 0.052 mm; breadth, 0.007. Striæ 8 in 0.01 mm. Common.

NAVICULA LANCEOLATA (Agardh) Kütz. var. **TENUIROSTRIS** var. nov. Plate 8, fig. 28.

Valve lanceolate with elongate subrostrate ends. Length, 0.037 mm; breadth, 0.0068. Axial area narrow, central area broad. Striæ radiate throughout, distinctly lineate, 7 to 8 in the middle, 12 at the ends, in 0.01 mm. Differs from the type in its elongate and subrostrate ends. Uncommon.

NAVICULA GRACILIS Ehr. Plate 9, fig. 14.

Navicula gracilis Ehr., FR. HUSTEDT, Bacillar. (1930) 299, fig. 514.

Navicula vulpina Kütz. var. *oregonica* Cleve fo. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 62.

Valve linear-lanceolate with long, obtuse ends. Length, 0.068 to 0.076 mm; breadth, 0.0085 to 0.009. Median line filiform with distinct, comma-shaped, terminal fissures. Axial area narrow; central area orbicular. Striæ radiate, divergent in the middle, and convergent at the ends. Striæ lineate, 10 to 11 in 0.01 mm. Infrequent.

NAVICULA ROSTELLATA Kütz. Plate 8, fig. 31; Plate 9, fig. 23.

Navicula rostellata Kütz., FR. HUSTEDT, Bacillar (1930) 297, fig. 502.

Valve narrow-elliptic-lanceolate with subrostrate ends. Length, 0.044 to 0.059 mm; breadth, 0.0085 to 0.009. Axial area indistinct, narrow; central area orbicular with a siliceous rib from one side of the median line. Striæ radiate, lineate, 10 to 11 in 0.01 mm, convergent at the ends. Common.

NAVICULA PSEUDOGRACILIS sp. nov. Plate 9, figs. 20 and 21.

Valve linear-lanceolate with parallel margins, attenuate at the subacute ends. Length, 0.051 to 0.064 mm; breadth, 0.0083. Median line filiform with distinct, comma-shaped, terminal fissures, bordered on one or on both sides by a siliceous rib. Axial area very narrow, indistinct; central area widened or truncate outward. Striæ slightly radiate, little divergent in the middle and convergent at the ends, 11 in 0.01 mm. Differs from *N. gracilis* Ehr. in its lineate striæ and distinct siliceous rib on one or both sides of the median line. Uncommon.

NAVICULA HASTA Pant. Plate 7, figs. 11 and 19.

Navicula hasta Pant., FR. HUSTEDT, Bacillar. (1930) 306, fig. 541.

Valve lanceolate, gradually tapering to the subacute ends. Length, 0.07 to 0.093 mm; breadth, 0.012 to 0.017. Median line filiform, straight, with small, comma-shaped, terminal fissures. Striæ radiate throughout, lineate, 9 to 10 in 0.01 mm. Differs from the type in its gradually attenuate and not slightly undulate ends. Uncommon.

NAVICULA MAGNA sp. nov. Plate 8, figs. 25 and 27; Plate 9, fig. 36.

Pinnularia baicalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 23, pl. 2, fig. 82.

Valve linear-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.079 to 0.18 mm; breadth, 0.012 to 0.019. Median line filiform with large, distinct, fork-shaped, terminal fissures. Central pores distinct. Axial and central areas broad-lanceolate, about half of the valve diameter. Striæ robust, lineate, radiate throughout, 5 to 8 in 0.01 mm, alternately

longer and shorter along both sides of the valve. A distinct form common in Baikal.

NAVICULA MAGNA sp. nov. var. **LANCEOLATA** var. nov. Plate 9, fig. 28.

Differs from the type in its more attenuate ends. Length, 0.105 mm; breadth, 0.013. Striæ lineate, not so irregularly interrupted as in the type, 5 to 6.5 in 0.01 mm. Axial and central areas broad lanceolate. Common.

NAVICULA MAGNA sp. nov. var. **CURTA** var. nov. Plate 10, fig. 14.

Pinnularia hemiptera Kütz. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 22, pl. 1, fig. 71.

Differs from the type in its shorter and broader valves. Length, 0.153 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

NAVICULA GASTRUM Ehr. Plate 7, fig. 36.

Navicula gastrum Ehr., FR. HUSTEDT, Bacillar. (1930) 305, fig. 537.

Valve broad-elliptic with short subrostrate ends. Length, 0.042 mm; breadth, 0.015. Median line straight, fine. Terminal fissures indistinct. Axial area narrow; central area broad. Striæ radiate, not lineate, 11 in 0.01 mm; in the middle part alternately longer and shorter. Rare.

NAVICULA VULPINA Kütz. Plate 9, fig. 6.

Navicula vulpina Kütz., A. SCHMIDT, Atlas Diatom. (1876) pl. 47, figs. 53, 54.

Valve lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.068 mm; breadth, 0.012. Striæ radiate, lineate, convergent at the ends, 10 to 11 in 0.01 mm. Common.

NAVICULA VULPINA Kütz. var. **OREGONICA** Cleve. Plate 7, fig. 24.

Navicula viridula Kütz., A. SCHMIDT, Atlas Diatom. (1876) pl. 47, figs. 55, 56.

Differs from the type in its more lanceolate valves. Length, 0.074 mm; breadth, 0.013. Striæ 9 in 0.01 mm. Known as a fossil from Oregon, North America.

NAVICULA PEREGRINA (Ehr.) Kütz. Plate 7, fig. 8; Plate 8, fig. 19.

Navicula peregrina Ehr., A. SCHMIDT, Atlas Diatom. (1876) pl. 47, fig. 60.

Valve lanceolate with broad, obtuse ends. Length, 0.074 to 0.076 mm; breadth, 0.017 to 0.019. Striæ radiate, robust, lineate, 6 in 0.01 mm in the middle part, and 9 in 0.01 mm at the ends. Known from brackish waters. Uncommon.

NAVICULA PEREGRINA (Ehr.) Kütz. var. KEFRINGENSIS (Ehr.) Cleve? Plate 8, fig. 9.

Valve 0.049 mm in length, 0.01 in breadth. Our valves are not similar to Schmidt's figures.[9]

NAVICULA LACUS BAIKALI Skv. and Meyer. Plate 7, fig. 23; Plate 9, fig. 3.

Navicula Lacus Baikali SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 69.

Valve lanceolate with obtuse ends. Length, 0.074 to 0.136 mm; breadth, 0.02 to 0.03. Axial area narrow; central area orbicular. Median line straight, with distinct, comma-shaped, terminal fissures and distinct central pores. Striæ robust, slightly radiate throughout and not convergent at the ends, 6 to 10 in 0.01 mm, distinctly lineate. Striæ on both sides of the median line are crossed by a narrow, blank area. A distinct species closely related to *N. Haueri* Grun., which is distinguished only by convergent striæ in the ends of the valves and the presence of lunate markings near the central nodule. *Navicula Haueri* Grun. is known as a brackish-water fossil from Hungary (Dubravica, Bory).[10] Another related species, *N. Phi* Cleve, is a marine form from Seychelles.[11]

NAVICULA LACUS BAIKALI Skv. and Meyer var. SIMPLEX Skv. and Meyer. Plate 9, fig. 8; Plate 10, fig. 7.

Navicula Lacus Baikali Skv. and Meyer var. *simplex* SKVORTZOW and MEYER, Contribution to the diatoms from Baikal Lake (1928) 20, pl. 1, fig. 70.

Differs from variety *baikalensis* in its small valves with a distinct narrow blank area or with only few interrupted striæ. Length, 0.049 mm; breadth, 0.015. Striæ 7 to 8 in 0.01 mm. Common.

NAVICULA LACUS BAIKALI Skv. and Meyer var. LANCEOLATA var. nov. Plate 7, fig. 9; Plate 8, fig. 13.

Navicula Lacus Baikali SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 68.

Valve lanceolate with long, subacute ends. Length, 0.057 to 0.096 mm; breadth, 0.017 to 0.024. Striæ 7 to 8 in 0.01 mm, crossed by a broad blank area. Differs from the type in its long acute ends. Common.

[9] Schmidt, op. cit. (1876) pl. 47, figs. 61, 62.

[10] Grunow, Beiträge zur Kenntniss der Fossilen Diatom. Österreich-Ungarns (1882) 143, pl. 30, fig. 48; Pantocsek, Beiträge zur Kenntniss der Fossilen Bacil. Ungarns (1903) 3, pl. 8, fig. 135.

[11] Cleve, Synopsis of the naviculoid Diatoms (1895) 2, 34, pl. 1, fig. 34.

NAVICULA TUSCULA (Ehr.) Grun. Plate 8, fig. 3.

Navicula tuscula (Ehr.) Grun., A. SCHMIDT, Atlas Diatom. (1911) pl. 272, figs. 24–27; FR. HUSTEDT, Bacillar. (1930) 308, fig. 552.

Valve elliptic-lanceolate with subrostrate ends. Length, 0.049 mm; breadth, 0.015. Median line filiform or slightly sigmoid in the middle part. Axial area very narrow; central area oblique and broad of different size. Striæ radiate, 10 to 12 in 0.01 mm, of longitudinal puncta, forming irregular longitudinal rows. Common.

NAVICULA MEYERI sp. nov. Plate 7, fig. 27; Plate 9, figs. 29 and 42.

Valve lanceolate gradually tapering to the subacute ends. Length, 0.032 to 0.081 mm; breadth, 0.013 to 0.022. Median line very distinct with small, comma-shaped, terminal fissures and curved in the middle part. Axial area narrow; central area suborbicular. Striæ distinct, 10 to 12 in 0.01 mm, punctate. Puncta elongate, forming irregular longitudinal rows on both sides of the valve. Differs from *N. tuscula* (Ehr.) in its curved median line, suborbicular central area, and striæ mostly punctate and not elongate. Named in honor of Prof. K. I. Meyer, of Moscow.

NAVICULA ANGLICA Ralfs. Plate 7, figs. 13, 16?, 32.

Navicula anglica Ralfs, FR. HUSTEDT, Bacillar. (1930) 303, figs. 530–531.

Valve elliptic with subrostrate ends. Length, 0.025 to 0.029 mm; breadth, 0.0085 to 0.012. Median line slightly arcuate. Axial area linear, narrow; central area small, suborbicular. Striæ radiate throughout, not lineate or finely lineate, 8 to 12 in 0.01 mm. A common fresh-water diatom.

NAVICULA ANGLICA Ralfs var. SUBSALSA Grun. Plate 9, fig. 47.

Navicula anglica Ralfs var. *subsalsa* Grun., VAN HEURCK, Synopsis (1880–1881) pl. 8, fig. 31.

Differs from the type in its more obtuse ends. Length, 0.023 mm; breadth, 0.0085. Striæ radiate throughout, not lineate, 9 in 0.01 mm. Known from slightly brackish water. Rare.

NAVICULA EXIGUA (Greg.) O. Müll. Plate 8, fig. 2.

Navicula exigua (Greg.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 305, fig. 538.

Valve elliptic-lanceolate with rostrate ends. Length, 0.025 mm; breadth, 0.0085. Median line straight. Axial area linear, narrow; central area orbicular. Striæ radiate, not lineate, in the middle alternately longer and shorter, 12 in 0.01 mm. Rare.

NAVICULA PLACENTULA (Ehr.) Grun. Plate 9, fig. 2.

Navicula placentula (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 303, fig. 532.

Valve elliptic-lanceolate with cuneate ends. Length, 0.052 mm; breadth, 0.02. Striæ radiate, robust, not lineate, 6 in 0.01 mm. Differs from the type in its nonlineate striæ. Common.

NAVICULA PLACENTULA (Ehr.) Grun. fo. **JENISSEYENSIS** (Grun.) Meister. Plate 7, fig. 34; Plate 8, fig. 30.

Navicula gastrum var. *jenisseyensis* Grun., CLEVE and GRUNOW, Beiträge zur Kenntniss der Arctischen Diatomeen (1880) 31, pl. 1, fig. 28.

Valve lanceolate with attenuate ends. Length, 0.04 to 0.102 mm; breadth, 0.012 to 0.025. Median line straight with small, comma-shaped, terminal fissures and distinct central pores. Axial area narrow; central area orbicular. Striæ radiate, fine, not lineate, 6 to 7 in 0.01 mm. According to Grunow the type specimens have very fine lineate striæ. Infrequent.

NAVICULA PLACENTULA (Ehr.) Cleve fo. **ROSTRATA** A. Meyer. Plate 9, figs. 30, 44, and 46.

Navicula placentula (Ehr.) Cleve fo. *rostrata* A. Meyer, FR. HUSTEDT, Bacillar. (1930) 304, fig. 533.

Two forms were recognized: (*a*) Valve short elliptic with subrostrate ends. Length, 0.027 mm; breadth, 0.012. Striæ 9 in 0.01 mm, lineate (Plate 5, fig. 34). (*b*) Valve elliptic with subrostrate ends. Length, 0.034 to 0.056 mm; breadth, 0.017 to 0.036. Striæ not lineate, 7 to 9 in 0.01 mm (Plate 5, figs. 35 and 39). Both forms are common.

NAVICULA SUBPLACENTULA Hust. var. **BAIKALENSIS** var. nov. Plate 9, fig. 31.

Valve lanceolate with subacute ends. Length, 0.079 mm; breadth, 0.029. Median line filiform with comma-shaped terminal fissures. Axial area linear; central area suborbicular. Striæ radiate throughout, 4 in 0.01 mm. Striæ double punctate. A distinct species with double punctate, robust striæ, known from fresh water of Tanganyika Lake, Africa.[12] The Baikal form differs from the type in its more elliptic valves and in the terminal part of its median line.

NAVICULA ANNULANA Grun. var. **BAIKALENSIS** var. nov. Plate 8, fig. 17.

Valve rhomboidal and obtuse. Length, 0.034 mm; breadth, 0.015. Median line filiform, straight, with small, comma-shaped, terminal fissures. Central nodules distinct. Axial area narrow,

[12] Schmidt, Atlas Diatom. (1930) pl. 370, fig. 7.

linear; central area suborbicular. Striæ strongly radiate, in the middle part alternately longer and shorter, not lineate, 10 in 0.01 mm. Differs from the type in its smaller valves and its broader appearance. *Navicula annulata* Grun. is known from Demarara River, South America.[13]

NAVICULA MENISCULUS Schumann. Plate 7, fig. 30.

Navicula menisculus Schumann, FR. HUSTEDT, Bacillar. (1930) 301, fig. 517.

Valve elliptic with acute ends. Length, 0.034 mm; breadth, 0.01. Striæ radiate, lineate, 10 in 0.01 mm. Rare.

NAVICULA SUBOCCULATA Hust. var. UNILATERALIS var. nov. Plate 9, fig. 13.

Valve linear with parallel margins and broad rounded ends. Axial area narrow; central area a broad rectangular fascia, larger on one side of the valve than on the other. Striæ 21 to 22 in 0.01 mm. Differs from the type in its smaller size, coarser striæ, and in the central area. *Navicula subocculata* Hust. is known from the bottoms of European lakes.[14]

NAVICULA SUBOCCULATA Hust. var. BAIKALENSIS var. nov. Plate 7, fig. 26.

Smaller than the type. Length, 0.0068 mm; breadth, 0.0029. Striæ about 30 in 0.01 mm. Rare.

NAVICULA UNIPUNCTATA sp. nov. Plate 8, fig. 10.

Valve lanceolate with acute ends. Length, 0.037 mm; breadth, 0.015. Median line straight with small, comma-shaped, terminal fissures. Axial area narrow; central area broad. Striæ radiate, not lineate, in the middle part alternately longer and shorter, 8 in 0.01 mm, with an isolated punctum between the central pores. This is a distinct species and does not belong to *Cymbella*.

NAVICULA PARADOXA sp. nov. Plate 8, fig. 4.

Valve elliptic-lanceolate with subrostrate ends. Median line filiform with indistinct, terminal fissures. Axial and central areas broad-lanceolate, about one-third of the valve breadth. Length, 0.025 mm; breadth, 0.012. Striæ robust, compact, not lineate, slightly radiate, 8 in 0.01 mm, with more distinct and thickened axial and central areas. A distinct species.

NAVICULA GRANULIFERA sp. nov. Plate 8, fig. 1.

Valve elliptic-lanceolate with slightly subrostrate ends. Length, 0.056 mm; breadth, 0.017. Median line straight, en-

[13] Cleve, Synopsis of naviculoid Diatoms (1895) 2, 33, pl. 1, fig. 38.

[14] Hustedt, Bacillar. (1930) 307, fig. 546.

larged in the middle part, with distinct, comma-shaped, terminal fissures and distinct central nodules. Axial area lanceolate; central area broader. Striæ radiate, not punctate, 8 in 0.01 mm. Between striæ distinct puncta in two or three irregular longitudinal lines. A peculiar form. Uncommon in Baikal.

NAVICULA DELICATULA sp. nov. Plate 8, fig. 12.

Valve lanceolate, gradually tapering from the middle towards the subacute ends. Length, 0.044 mm; breadth, 0.0085. Median line filiform with indistinct terminal fissures. Axial area narrow; central area a broad stauros. Striæ radiate, not lineate, 15 in 0.01 mm. A delicate, slightly siliceous species. Uncommon in Baikal.

NAVICULA ACUTA sp. nov. Plate 8, fig. 36.

Valve lanceolate, gradually tapering towards the acute ends. Length, 0.047 mm; breadth, 0.017. Median line filiform with indistinct terminal fissures. Axial area narrow, linear; central area broad, quadrate. Striæ radiate throughout, 12 to 13 in 0.01 mm, composed of minute indistinct puncta. A species connected with *N. amphibola* Cleve.

NAVICULA WISLOUCHII Skv. and Meyer. Plate 9, fig. 1.

Navicula Wislouchii SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 72.

Valve linear-rectangular with rostrate ends. The middle part somewhat constricted. Length, 0.064 to 0.091 mm; breadth, 0.02 to 0.023. Axial area linear; central area elliptic. Median line filiform, robust with comma-shaped fissures. Central pore distinct. Striæ slightly curved, radiate, 9 to 12 in 0.01 mm. Striæ distinctly punctate, puncta 9 in 0.01 mm, forming irregular, longitudinal, undulating costæ. A species akin to *N. scoliopleuroides* Quint, known from hot springs near Budapest.

NAVICULA WERESTSCHAGINI Skv. and Meyer. Plate 7, fig. 5; Plate 10, fig. 2.

Navicula Werestschagini SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 64.

Valve lanceolate-elliptic with attenuate, subacute ends. Length, 0.056 to 0.103 mm; breadth, 0.027 to 0.034. Median line robust, enlarged in the middle part with comma-shaped terminal fissures and distinct central nodules. Axial area narrow, indistinct; central area suborbicular. Striæ radiate throughout, punctate, 5 to 6 in 0.01 mm. Puncta very distinct, 5 to 7.5 in 0.01 mm, arranged in irregular longitudinal rows.

A large and distinct species akin to many large punctate forms; for instance, *N. Schulzii* Kain. and var. *californica* Cleve, known as a fossil from Atlantic City, New Jersey, and from San Pedro, California.[15]

NAVICULA LACUSTRIS Greg. Plate 8, fig. 5; Plate 10, fig. 6.

Navicula lacustris Greg., CLEVE, Diatoms of Finland (1891) 34, pl. 2, fig. 14.

Valve lanceolate with subrostrate ends. Length, 0.059 to 0.061 mm; breadth, 0.02 to 0.022. Median line filiform with comma-shaped terminal fissures. Axial area narrow; central area suborbicular. Striæ radiate, punctate, 11 to 12 in 0.01 mm. The marginal puncta are coarser, the puncta approaching axial area are broader and disposed in irregular longitudinal ribs. Common.

NAVICULA LACUSTRIS Greg. var. ELONGATA Skv. and Meyer.

Navicula lacustris Greg. var. *elongata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 18, pl. 1, fig. 61.

Valve longer and broader. Length, 0.09 mm; breadth, 0.022. Striæ 8 in 0.01 mm. Rare.

NAVICULA LACUSTRIS Greg. var. BAIKALENSIS var. nov. Plate 7, fig. 21.

Differs from the type in its broader axial and central areas and more robust striæ. Length, 0.056 mm; breadth, 0.022. Axial area broad; central area orbicular. Striæ radiate, punctate, 6 in 0.01 mm. Puncta 15 in 0.01 mm. Infrequent.

NAVICULA SCUTELLOIDES W. Smith var. BAIKALENSIS var. nov. Plate 9, fig. 40.

Differs from the type and variety *minutissima* Cleve in its suborbicular valves with obsolete striæ. Length, 0.01 mm; breadth, 0.0078. Striæ not punctate, 18 to 20 in 0.01 mm. *Navicula scutelloides* and variety *minutissima* Cleve are reported from fresh and brackish waters.[16]

NAVICULA TORNEENSIS Cleve var. ABOENSIS Cleve. Plate 5, fig. 17; Plate 8, fig. 11; Plate 9, figs. 18 and 43.

Navicula torneensis Cleve var. *aboensis* CLEVE, Diatoms of Finland (1891) 33, pl. 2, fig. 7; WISLOUCH and KOLBE, Beiträge zur Diatomeenflora des Onega-sees (1927) 45, pl. fig. 9.

Diploneis Mauleri Brun. var. *borussica* Cleve fo. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) pl. 1, fig. 28.

[15] Pantocsek, Beiträge zur Kenntniss der Fossilen Bacillarien Ungarns (1893) 3, pl. 34, fig. 481.

[16] P. Cleve, Synopsis naviculoid Diatoms (1895) 2, 40; P. Cleve, Diatomaceer fram Gronland och Argentinska republiken (1881) 12, pl. 16, fig. 10.

Valve elliptic, minute with broad rounded ends. Length, 0.0085 to 0.021 mm; breadth, 0.005 to 0.009. Median line filiform with indistinct terminal fissures. Axial and central areas narrow-lanceolate. Striæ distinctly punctate, slightly radiate throughout, 11 to 12 in 0.01 mm. Puncta 12 in 0.01 mm. The first row of puncta, opposite the median line, is interrupted from both sides with a longitudinal blank band. A distinct species very common in Baikal Lake, in Finland, and in Onega Lake of northern Europe.

NAVICULA AMPHIBOLA Cleve var. CURTA var. nov. Plate 9, fig. 4.

Valve elliptic-lanceolate with cuneate ends. Length, 0.037 mm; breadth, 0.028. Median line straight. Axial area narrow; central area widened and truncate outward. Striæ strongly radiate, punctate, 7 in 0.01 mm. Puncta 10 in 0.01 mm. Differs from the type in its shorter valves. Rare.

NAVICULA DAHURICA sp. nov. Plate 7, fig. 35; Plate 8, fig. 7.

Valve elliptic-lanceolate with slightly subrostrate ends. Length, 0.049 to 0.081 mm; breadth, 0.0187 to 0.028. Median line straight with distinct, comma-shaped, terminal fissures and distinct central pores. Axial area linear, somewhat dilated to the central area; central area suborbicular. Striæ radiate throughout, punctate, 5 to 7 in 0.01 mm. Puncta 15 to 18 in 0.01 mm. Middle striæ alternately longer and shorter. A species akin to *N. amphibola* Cleve and *N. pumilla* W. Smith. Common.

Genus PINNULARIA Ehrenberg

PINNULARIÆ PARALLELISTRIATÆ FR. HUSTEDT

PINNULARIA MOLARIS Grun. Plate 11, fig. 9.

Pinnularia molaris Grun., FR. HUSTEDT, Bacillar. (1930) 316, fig. 568.

Valve linear-lanceolate with parallel margins and broad ends. Length, 0.051 mm; breadth, 0.0085. Striæ slightly radiate, divergent in the middle and slightly convergent at the ends, 21 in 0.01 mm. Axial area narrow; central area a broad quadrate fascia. Rare.

PINNULARIA LEPTOSOMA Grun. Plate 9, fig. 26.

Pinnularia leptosoma Grun., FR. HUSTEDT, Bacillar. (1930) 316, fig. 567.

Valve lanceolate, gradually attenuate towards the ends. Length, 0.025 mm; breadth, 0.0042. Striæ radiate, 18 to 20 in 0.01 mm. Central area a broad and long stauros. Known from mountain districts. Rare.

PINNULARIÆ TABELLARIÆ CLEVE

PINNULARIA GIBBA Ehr. var. **BAIKALENSIS** var. nov. Plate 11, fig. 17.

Valve linear-lanceolate with convex middle part and attenuate ends, triundulate. Length, 0.085 mm; breadth, 0.01. Median line robust, straight with distinct, comma-shaped, terminal fissures. Axial area dilated to the middle part of the valve, forming a broad transversely truncate stauros. Striæ robust, 8 in 0.01 mm. Differs from the form *subundulata* Mayer in its more robust median line and more convex median part of the valve. Rare.

PINNULARIA PECTINALIS sp. nov. Plate 11, fig. 10.

Valve lanceolate with gibbous middle part and elongate broad ends. Length, 0.059 mm; breadth, 0.01. Median line enlarged in the middle part with distinct comma-shaped terminal fissures and oblique central pores. Axial and central areas lanceolate with a siliceous rib on both sides of median line and central pore. Central area a broad quadrate stauros. Striæ radiate without longitudinal bands, 9 in 0.01 mm. A distinct species not closely connected with the others. Common in Baikal.

PINNULARIA PECTINALIS sp. nov. var. **ROSTRATA** var. nov. Plate 11, figs. 11 and 12.

Differs from the type in its broad elliptic-lanceolate valves with rostrate ends. Length, 0.035 mm; breadth, 0.0068 to 0.0085. Striæ 9 to 10 in 0.01 mm, divergent in the middle, and convergent at the ends. Stauros very broad. Common.

PINNULARIÆ MAIORES CLEVE

PINNULARIA MAJOR (Kütz.) Cleve. Plate 11, fig. 5.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 331, fig. 614.

Valve linear with broad rounded ends. Length, 0.146 mm; breadth, 0.023. Striæ 6 in 0.01 mm. Rare.

PINNULARIA MAJOR (Kütz.) Cleve fo. **MINOR** fo. nov. Plate 11, fig. 16.

Valve linear with obtuse ends. Length, 0.102 mm; breadth, 0.0136. Median line oblique, broad with distinct terminal fissures. Axial and central areas broad. Striæ radiate, divergent in the middle and convergent at the ends, 7 in 0.01 mm, with distinct longitudinal bands. Recently found in Argun River, northern Manchuria.

PINNULARIA CRASSA sp. nov. Plate 11, fig. 22.

Valve lanceolate-elliptic with slightly attenuate and broad ends. Length, 0.091 mm; breadth, 0.02. Median line robust

with distinct, comma-shaped, terminal fissures. Central nodules large and curved. Axial area narrow-lanceolate; central area suborbicular. Striæ robust, slightly divergent in the middle and convergent at the ends, 7 in 0.01 mm. Striæ without longitudinal bands. A species distinct in its robust striæ and oblique median line. Rare.

PINNULARIÆ BAIKALIÆ NOB.

Three peculiar species of *Pinnularia* found in Baikal Lake have very distinct central pores not known in any representative of the genus *Pinnularia*. The central pores of these diatoms are joined together by a siliceous handle twisted inside of the central nodule. I propose to unite these three new species, *P. Lacus Baikali, P. abnormis,* and *P. viridissima,* under a new group, Pinnulariæ Baikaliæ nob.

PINNULARIA LACUS BAIKALI sp. nov. Plate 11, figs. 2, 3, and 21.

Pinnularia Passargerei Reich. var. *baikalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 23, pl. 2, fig. 81.

Valve linear-lanceolate, slightly constricted in the middle and with subrostrate, broad rounded ends. Length, 0.105 to 0.170 mm; breadth, 0.025 to 0.035. Median line broad, slightly sigmoid with distinct, comma-shaped, terminal fissures. Central pores joined together by a siliceous handle twisted inside of the central nodule. Axial area broad; central area forming a stauros, longer on one side of the valve than on the other, or the central area unilaterally interrupted. Striæ robust, slightly divergent in the middle and convergent at the ends, with distinct longitudinal bands. Striæ 5 in 0.01 mm. A distinct variable species known only in Baikal. Very common.

PINNULARIA LACUS BAIKALI sp. nov. var. GIBBOSA var. nov. Plate 11, fig. 18.

Valve gibbous in the middle part. Ends subcapitate. Length, 0.132 mm; breadth, 0.025. Striæ 7 in 0.01 mm. Rare.

PINNULARIA LACUS BAIKALI sp. nov. var. LANCEOLATA var. nov. Plate 11, fig. 20.

Valve elliptic-lanceolate with subacute ends. Length, 0.142 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

PINNULARIA LACUS BAIKALI sp. nov. var. LINEARIS var. nov. Plate 11, fig. 6.

Valve linear with parallel margins and slightly attenuate ends. Length, 0.221 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

PINNULARIA ABNORMIS sp. nov. Plate 11, fig. 1.

Valve linear-lanceolate, undulate in the middle part, and attenuate towards the obtuse ends. Length, 0.17 mm; breadth,

0.023. Median line curiously enlarged, linear with large, comma-shaped, terminal fissures. Central pores connected by an intermediate siliceous band. Axial area indistinct; central area lanceolate. Striæ robust, divergent in the middle, and convergent at the ends, 5 to 6 in 0.01 mm. Longitudinal bands distinct. A very peculiar *Pinnularia* of a primitive habit. Common.

PINNULARIA VIRIDISSIMA sp. nov. Plate 11, fig. 15.

Valve elliptic-lanceolate with obtuse ends. Length, 0.074 to 0.105 mm; breadth, 0.015 to 0.022. Median line straight with comma-shaped terminal fissures and with central pores connected by an intermediate siliceous band. Axial area broad; central area orbicular. Striæ radiate, divergent in the middle, and convergent at the ends, 7 to 8 in 0.01 mm, with two distinct bands. Rare.

AMPHORA OVALIS Kütz. Plate 12, fig. 24.

Amphora ovalis Kütz., FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Valve lunate with obtuse ends. Length, 0.047 mm; breadth, 0.025. Dorsal striæ 10 to 11 in 0.01 mm; ventral striæ 11 to 12 in 0.01 mm. Striæ distinctly punctate. Rare.

AMPHORA OVALIS Kütz. var. PEDICULUS Kütz. Plate 12, fig. 2.

Amphora ovalis Kütz. var. *pediculus* Kütz., FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Frustule small, elliptic. Length, 0.022 mm; breadth, 0.009. Valve with gibbous ventral side. Dorsal striæ 13 to 14, ventral 15, in 0.01 mm. Central area a rectangular fascia. Infrequent.

AMPHORA OVALIS Kütz. fo. GRACILIS (Ehr.) Cleve. Plate 12, fig. 10.

Amphora ovalis Kütz. fo. *gracilis* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Frustule elliptic with abrupt ends. Length, 0.023 mm; breadth, 0.01. Valve with straight ventral side. Dorsal and ventral striæ 12 in 0.01 mm, distinctly punctate. Rare.

AMPHORA OVALIS Kütz. var. CONSTRICTA var. nov. Plate 12, fig. 17.

Frustule elliptic-rectangular and slightly constricted. Length, 0.034 mm; breadth, 0.012. Striæ distinctly punctate, ventral 12, dorsal 10, in 0.01 mm. Rare.

AMPHORA NORMANI Rabh. Plate 12, fig. 5.

Amphora Normani Rabh., FR. HUSTEDT, Bacillar. (1930) 343, 344, fig. 630.

Valve lunate with triundulate dorsal margin and slightly constricted ventral side. Ends subrostrate. Length, 0.022 mm; breadth, 0.0034. Axial and central areas broad. Striæ only marginal on the dorsal side, 18 in 0.01 mm. Rare.

AMPHORA PERPUSILLA Grun. Plate 12, fig. 22.

Amphora perpusilla Grun., FR. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Frustule elliptic with abrupt ends. Length, 0.017 mm; breadth, 0.0068. Striæ 18 in 0.01 mm. Rare.

AMPHORA MONGOLICA Oestrup. Plate 12, fig. 21.

Amphora mongolica OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. Hedwigia 48 (1909) pl. fig. 1.

Valve lunate, arcuate with almost straight ventral margin and acute ends. Median line slightly biarcuate with distinct central pores. Axial and central areas long-lanceolate, surrounded from the dorsal side by a distinct siliceous rib. Length, 0.062 mm; breadth, 0.042. Striæ of dorsal side 9 in 0.01 mm, in the middle part compact; others are formed by longitudinal alveoli in longitudinal lines. Ventral margin with a row of short beads, 9 in 0.01 mm, interrupted in the middle part. A distinct species, known from Kossogol and Baikal Lakes as recently reported by me from western China. Differs from *A. ovalis* Kütz. in the presence of a siliceous rib along the median line from the dorsal side and by compact striæ from the dorsal side near the central area. Common.

AMPHORA MONGOLICA Oestrup var. GRACILIS var. nov. Plate 12, fig. 13.

Valve longer in outline with attenuate ends. Length, 0.149 mm. The interrupted middle part of the ventral side with four short distinct costæ. Striæ of dorsal and ventral margins 9 in 0.01 mm. Infrequent.

AMPHORA MONGOLICA Oestrup var. CORNUTA var. nov. Plate 12, fig. 6.

Differs from the type in the presence of two horn-shaped projections on the middle part of the dorsal side near the central pores. Length, 0.153 mm; breadth, 0.034. Striæ of ventral and dorsal sides 8 in 0.01 mm. Common.

AMPHORA MONGOLICA Oestrup var. CORNUTA fo. INTERRUPTA fo. nov. Plate 12, fig. 7.

Differs from var. *cornuta* in the presence of a broad blank band in the middle part of the dorsal side of the valve. Length,

0.122 mm; breadth, 0.03. Striæ, ventral 6, dorsal 7, in 0.01 mm. Common.

AMPHORA MONGOLICA Oestrup var. BAIKALENSIS Skv. and Meyer. Plate 12, fig. 8.

Amphora mongolica Oestrup var. *baicalensis* SKV. and MEYER, Contribution to the diatoms of Baikal Lake (1928) 37, pl. 3, fig. 170.

Differs from the type in the presence of broad axial and central areas from the dorsal side with isolated puncta near the central pores. Length, 0.088 mm; breadth, 0.02. Striæ 7 in 0.01 mm. Rare.

AMPHORA COSTULATA sp. nov. Plate 12, fig. 1.

Valve lunate with long attenuate ends. Length, 0.032 mm; breadth, 0.006. Dorsal side with robust not punctate striæ, 11 in 0.01 mm. Ventral side with a row of short striæ, interrupted in the middle part. A species akin to *A. mongolica* Oestrup. Infrequent.

AMPHORA SIBIRICA Skv. and Meyer. Plate 12, figs. 12, 14, 23, 26, and 27.

Amphora sibirica SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36–37, pl. 3, fig. 168.

Frustule elliptic with rounded ends. Length, 0.03 to 0.052 mm; breadth, 0.0085 to 0.018. Valve lunate with curved, straight, or slightly gibbous ventral side and broad rounded ends. Median line biarcuate with a siliceous rib on the dorsal side. Dorsal striæ punctate in irregular longitudinal rows. Puncta 9 to 12 in 0.01 mm, with a blank band across the striæ. Ventral side with a row of short striæ, interrupted in the middle part. A species related to *A. ovalis* Kütz., but more robust. Very common.

AMPHORA SIBIRICA Skv. and Meyer var. GRACILIS var. nov. Plate 12, fig. 19.

Differs from the type in its more elongate valve. Length, 0.057 mm; breadth 0.0085. Dorsal side with a broad, truncate, outward blank, band. Dorsal striæ 9, ventral 12, in 0.01 mm. Infrequent.

AMPHORA ROTUNDA sp. nov. Plate 12, fig. 18.

Frustule suborbicular with rostrate ends. Length, 0.04 mm; breadth, 0.035. Valve oblique-arcuate with almost straight ventral and arcuate dorsal sides. Median line slightly biarcuate, axial area indistinct with a siliceous rib along the dorsal side of the median line. Dorsal side constricted from two parts: marginal hyaline, and central striate. Striæ distinctly punctate. Central area distinct on the dorsal side with a blank band across

the striæ. Ventral side with a row of short striæ, interrupted in the middle part. A species akin to *A. sibirica* Skv. and Meyer.

AMPHORA DELPHINEA (Bail.) A. Smith. Plate 12, fig. 4.

Amphora delphinea (Bail.) A. Smith., A. SCHMIDT, Atlas Diatom. (1876) pl. 40, figs. 26, 27.

Frustule slightly siliceous, linear with parallel margins and broad rounded ends. Length, 0.085 mm; breadth, 0.022. Valve linear with oblique ends. Median line arcuate. Central area dilated to a stauros. Terminal fissures indistinct. Striæ almost parallel, 21 in 0.01 mm. Differs from the type in its more robust striæ. Known from tropical fresh water, Demerara River of South America; *A. delphinea* var. *minor* Cleve is known from Crane Pond, North America, from Demerara River of South America, and from Kizaki Lake, Nippon.

AMPHORA OBTUSA Greg. var. **BAIKALENSIS** var. nov. Plate 12, figs. 20 and 28.

Frustule elliptic-rectangular with obtuse ends, twice as long as broad. Length, 0.042 mm; breadth, 0.022. Valve elliptic-linear, lunate and obliquely rounded. Median line arcuate. Axial area indistinct; central area distinct. Dorsal side with three robust, siliceous, marginal interruptions, one in the middle, two others on the ends. Striæ almost parallel, very fine, 18 in 0.01 mm. Striæ of ventral side divergent in the middle, convergent at the ends, 24 in 0.01 mm. The type is reported from the North Sea and the Atlantic and Indian Oceans.[17]

AMPHORA PROTEUS Greg. var. **BAIKALENSIS** var. nov. Plate 12, figs. 16 and 25.

Frustule elliptic with obtuse ends. Length, 0.049 mm; breadth, 0.022. Valve lunate with slightly gibbous ventral side and subacute ends. Median line slightly biarcuate. Axial and central areas on the dorsal side indistinct. Dorsal part in the middle with compact striæ, with alveolate striæ at the ends about 9 in 0.01 mm. Ventral side with two distinct rows of striæ of 12 in 0.01 mm. Differs from the type in its striæ of the middle part of the dorsal side. *Amphora Proteus* Greg. is a marine diatom, common in the North Sea.[18]

CYMBELLA HUSTEDTII Krasske? Plate 12, fig. 15; Plate 13, fig. 16.

Cymbella Hustedtii Krasske, FR. HUSTEDT, Bacillar. (1930) 363, fig. 674.

[17] Schmidt, Atlas Diatom. (1876) pl. 40, figs. 4–7, 11–13.
[18] Schmidt, op. cit. (1875) pl. 27, fig. 6.

Valve asymmetric, elliptic-lanceolate with broad ends. Length, 0.017 to 0.023 mm; breadth, 0.005 to 0.0065. Striæ radiate, dorsal 12, ventral 15, in 0.01 mm. Median line slightly oblique. Uncommon. The type is known from Europe.

CYMBELLA AMPHICEPHALA Naeg. var. UNIPUNCTATA Brun. Plate 8, fig. 8.

Cymbella amphicephala Naeg. var. *unipunctata* BRUN, Diatomees lacustres, marines ou fossil. Le Diatomiste 2 (1895) pl. 14, fig. 33.

Valve slightly asymmetric, naviculiform with subrostrate ends, and a distinct isolated punctum near the central nodule. Length, 0.018 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Rare. Known from alpine lakes in Europe.

CYMBELLA NAVICULA sp. nov. Plate 8, figs. 32 and 35; Plate 13, fig. 13.

Valve slightly asymmetric, naviculiform, broad elliptic-rectangular with short subrostrate ends. Length, 0.035 to 0.051 mm; breadth, 0.017 to 0.02. Median line slightly oblique with small terminal fissures. Axial area linear, abruptly dilated around the central nodule to an orbicular excentric central area. Striæ radiate, punctate, 6 to 8 in 0.01 mm. Puncta 18 in 0.01 mm. A species akin to *C. lata* Grun.

CYMBELLA LACUSTRIS Ag. fo. BAIKALENSIS Skv. and Meyer. Plate 14, fig. 9.

Cymbella lacustris Ag. fo. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 34, pl. 3, fig. 153.

Valve lanceolate, slightly asymmetric with long, broad, obtuse ends. Length, 0.068 to 0.074 mm; breadth, 0.012 to 0.015. Median line with long, distinct, terminal fissures. Axial area narrow; central area orbicular. Striæ radiate, 12 to 13 in 0.01 mm, compact not lineate. The type is known from fresh and brackish waters.[19]

CYMBELLA SINUATA Greg. Plate 13, fig. 14.

Cymbella sinuata Greg., FR. HUSTEDT, Bacillar. (1930) 361, fig. 668*b*.

Valve small, asymmetric, linear with obtuse ends. Length, 0.013 mm; breadth, 0.0034. Striæ 12 in 0.01 mm. Smaller than the type. Rare.

CYMBELLA TURGIDA (Greg.). Plate 12, fig. 9; Plate 13, fig. 28.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve lunate with slightly undulate dorsal and arcuate ventral side. Length, 0.032 to 0.068 mm; breadth, 0.0068 to 0.014. Median line straight, terminal fissures turned downward. Dor-

[13] Schmidt, op. cit. (1881) pl. 71, figs. 1–5.

sal striæ 9 to 10, ventral 7 to 9, in 0.01 mm. Common. Known in tropical regions.

CYMBELLA VENTRICOSA Kütz. Plate 12, fig. 11; Plate 13, figs. 11 and 18.

Cymbella ventricosa Kütz., FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Valve semielliptic. Length, 0.022 to 0.037 mm; breadth, 0.007. Striæ, dorsal and ventral, 11 to 12 in 0.01 mm. The specimen figured on Plate 12, fig. 27, was, in length, 0.025 mm; breadth, 0.0042. Striæ ventral 14 to 15, dorsal 15, in 0.01 mm. Common in Baikal.

CYMBELLA HETEROPLEURA Ehr. var. **MINOR** Cleve. Plate 13, figs. 12 and 15.

Cymbella sp., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 51, 52.

Valve slightly asymmetric, lanceolate with rostrate ends. Length, 0.037 to 0.08 mm; breadth, 0.013 to 0.022. Striæ 7 in the middle, 9 at the ends, in 0.01 mm. Common. Known from Arctic and northern regions. Some forms (Plate 13, fig. 12) are smaller than the type.

CYMBELLA CUSPIDATA Kütz. Plate 2, fig. 19; Plate 13, figs. 1 and 27?

Cymbella cuspidata Kütz., VAN HEURCK, Synopsis (1880–1881) 61, pl. 2, fig. 3.

Valve broad asymmetric, linear-lanceolate with subrostrate ends. Length, 0.044 to 0.085 mm; breadth, 0.014 to 0.024. Median line slightly arcuate. Axial area linear, slightly dilated in the middle. Striæ radiate, 10 to 11 in 0.01 mm. Puncta 16 to 18 in 0.01 mm. Common.

CYMBELLA EHRENBERGII Kütz. Plate 13, figs. 21 and 25.

Cymbella Ehrenbergii Kütz., VAN HEURCK, Synopsis (1880) pl. 2, figs. 1, 2.

Cymbella Gutwinskii Skv. and Meyer var. *intermedia* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 167.

Valve asymmetric, elliptic-lanceolate with subacuate ends. Length, 0.072 to 0.141 mm; breadth, 0.015 to 0.027. Central area suborbicular. Striæ 8 to 10 in the middle, 12 to 14 at the ends, in 0.01 mm. Common.

CYMBELLA MEISTERI Skv. and Meyer. Plate 13, figs. 6, 8, 20, and 26.

Cymbella Meisteri SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 165.

Valve asymmetric with slightly arcuate dorsal and ventral margins and long-attenuate, subacute ends. Length, 0.15 to 0.29 mm; breadth, 0.034 to 0.044. Median line arcuate with distinct

comma-shaped terminal fissures. Axial area narrow-linear; central area broad. Striæ radiate, linear, 5 to 8 in 0.01 mm. No rows of puncta below the central nodule. A distinct species known in Baikal. It has a slight resemblance to *C. Ehrenbergii* Kütz. var. *elongata* Meister, to which it was referred in my paper in 1928.[20]

CYMBELLA GUTWINSKII (Wisl.) Skv. and Meyer. Plate 13, figs. 7 and 22.

Cymbella Gutwinskii (Wisl.) SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 166.

Cymbella Ehrenbergii Kütz. var. *Gutwinskii* WISLOUGH, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-Sees (1924) 168, fig. 7.

Valve asymmetric, lanceolate with convex margins and long attenuate ends. Median line arcuate, axial area narrow, scarcely dilated in the middle. Length, 0.125 to 0.22 mm; breadth, 0.027 to 0.051. Striæ radiate, punctate, 8 to 11 in 0.01 mm. Common in Baikal. A distinct species akin to *C. Ehrenbergii* Kütz.

CYMBELLA PROSTRATA (Berkeley) Cleve. Plate 13, fig. 23.

Cymbella prostrata (Berkeley) Cleve, FR. HUSTEDT, Bacillar. (1930) 357, fig. 659.

Cymbella turgida var. *robusta* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 34, pl. 3, fig. 148.

Valve strongly asymmetric with obtuse ends. Length, 0.047 to 0.068 mm; breadth, 0.017 to 0.025. Median line straight with large and distinct, comma-shaped, terminal fissures. Axial area narrow, scarcely dilated in the middle part of the valve. Striæ robust, linear, 5 to 7 in 0.01 mm. Very common. Known from fresh and slightly brackish waters of Europe.

CYMBELLA INELEGANS Cleve var. BAIKALENSIS var. nov. Plate 13, fig. 10.

Cymbella turgida Greg. var. *genuina* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 34, pl. 3, fig. 147.

Valve boat-shaped with arcuate dorsal and convex ventral margins. Length, 0.047 to 0.076 mm; breadth, 0.015 to 0.023. Median line arcuate with reflexed terminal fissures. Axial and central areas linear. Striæ robust, linear, radiate, 7 in 0.01 mm. Differs from the type in its convex ventral margins and by the absence of terminal pores. The type is known from fresh water, and from Fall River, Oregon, as fossil.[21]

[20] Meister, Kieselalgen der Schweiz (1912) 188, pl. 32, fig. 3.

[21] Cleve, Synopsis of the naviculoid Diatoms (1894) 1, 168, pl. 5, fig. 1.

CYMBELLA PARVA (W. Smith) Cleve. Plate 12, fig. 3.

Cymbella parva W. Smith, A. SCHMIDT, Atlas Diatom. (1875) pl. 10, figs. 14, 15.

Valve lunate, centrally from the ventral margin, slightly convex, with end turned downward. Length, 0.028 mm; breadth, 0.0068. Median line somewhat arcuate. Axial and central areas semilanceolate. Striæ radiate, lineate, 8 to 9 in 0.01 mm. Rare. Known from northern regions.

CYMBELLA CISTULA (Hemprich) Grun. Plate 13, figs. 24 and 31.

Cymbella cistula (Hemprich) Grun. FR. HUSTEDT, Bacillar (1930) 363, fig. 676*a*.

Valve boat-shaped, centrally convex. Length, 0.057 to 0.078 mm; breadth, 0.013 to 0.015. Striæ 9 in 0.01 mm. Puncta 22 in 0.01 mm. At the ventral side of the central nodule are 1 to 3 small puncta, ending the median striæ. Common.

CYMBELLA CISTULA (Hemprich) Grun. var. MACULATA (Kütz.) Van Heurck.

Cymbella cistula (Hemprich) Grun. var. *maculata* (Kütz.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*b*.

Valve boat-shaped with slightly gibbous ventral margin. Length, 0.056 mm; breadth, 0.015. Striæ, ventral 10, dorsal 9, in 0.01 mm. No rows of puncta below the central nodule. Infrequent.

CYMBELLA CISTULA (Hemprich) Grun. var. ARCTICA Lagerst. Plate 3, fig. 9.

Cymbella cistula Hempr. var. *arctica* LAGERSTEDT, Sotvattens Diatomaceer fram Spitsbergen och Beeren Eiland (1873) pl. 10, fig. 12.

Valve boat-shaped with strongly arcuate dorsal and slightly concave ventral margin. Length, 0.09 mm; breadth, 0.017. Median line arcuate. Terminal fissures reflexed. Striæ, ventral and dorsal, 10 in 0.01 mm. Rare. Reported from Beeren Island, Spitzbergen, Lapland, and the mouth of Yenisei River, Siberia.

CYMBELLA STUXBERGII Cleve. Plate 13, fig. 9.

Cymbella Stuxbergii Cleve, CLEVE and GRUNOW, Beiträge zur Kenntniss der arctischen Diatomeen (1880) 13, pl. 1, fig. 10.

Valve arcuate with almost straight ventral margin, and subrostrate ends. Length, 0.062 mm; breadth, 0.018. Striæ, ventral and dorsal, 11 to 12 in 0.01 mm, crossed on the ventral side below the central nodule by a narrow depression. Known from the mouth of Yenisei River, from Koukounoor in western China, and common in Baikal.

CYMBELLA STUXBERGII Cleve var. INTERMEDIA Wisl. Plate 13, figs. 2, 3.

Cymbella Stuxbergii Cleve var. *intermedia* WISLOUCH, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees (1924) 170, fig. 1*a–e*.

Cymbella baicalensis Skv. and Meyer var. *Reinhardii* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 164.

Valve boat-shaped with concave, centrally slightly gibbous, ventral margin and truncate or rounded ends. Length, 0.161 mm; breadth, 0.024. Median line strongly arcuate. Striæ 8 to 9 in 0.01 mm, lineate, crossed on the ventral side below the central nodule by a narrow depression. Common in Baikal Lake.

CYMBELLA STUXBERGII Cleve var. BAIKALENSIS var. nov. Plate 13, figs. 5 and 19.

Cymbella baikalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 163.

Valve boat-shaped, strongly arcuate dorsal and almost straight ventral margins. Median line arcuate. Striæ 0.112 to 0.195 mm; breadth, 0.039 to 0.059. Striæ lineate, 6 to 8 in 0.01 mm. Lineolæ 8 in 0.01 mm. Striæ on the ventral side below the central nodule are crossed by a narrow depression. Common.

CYMBELLA AUSTRALICA A. Schmidt fo. ELONGATA Skv. and Meyer. Plate 13, figs. 4 and 17.

Cymbella australica A. Schmidt fo. *elongata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 32, pl. 3, fig. 143.

Valve boat-shaped, slightly gibbous in the ventral margin and long obtuse ends. Length, 0.17 to 0.204 mm; breadth, 0.029 to 0.032. Median line arcuate. Axial area narrow linear, central area abruptly dilated around the central nodule to an orbicular space. A distinct elongate stigma between the central pores. Striæ in the middle 6 to 7, at the ends 7 to 9, in 0.01 mm, slightly radiate and lineate. Common. The type is known from Australia, New Zealand, from Hanka Lake, eastern Siberia, and from Nippon.[22]

CYMBELLA CAPRICORNIS sp. nov. Plate 13, fig. 29.

Valve asymmetric with arcuate dorsal and convex ventral margins. Length, 0.074 mm; breadth, 0.017. Median line arcuate with distinct terminal fissures turned outward. Axial and central area semilanceolate, oblique. Striæ robust, radiate, punctate, not lineate, 7 in 0.01 mm. Puncta 12 in 0.01 mm. A form akin to *C. austriaca* Grun.

[22] Schmidt, Atlas Diatom. (1875) pl. 10, figs. 34, 35.

DIDYMOSPHENIA DENTATA Dorogostaisky. Plate 14, fig. 23.

Gomphonema dentata DOROGOSTAISKY, Materiaux pour servir a l'algologie du lac Baikal et de son bassin (1904) 256, pl. 6, figs. 1–3; C. I. MEYER and L. B. REINHARD, Contribution a la flore algologique du lac Baikal et de la Transbaikalie (1925) 212.

Didymosphenia dentata Dor. var. *genuina* Skv. and Meyer and fo. *elongata* SKVORTZOW and MEYER, Contribution to the diatoms of Bailkal Lake (1928) 31–32, pl. 3, figs. 139, 140.

Valve clavate, *Amphora*-shaped with gibbous middle part, abruptly attenuate, with subcapitate apex, and narrower, obtusely truncate base. Length, 0.076 to 0.178 mm; breadth, 0.048 to 0.054. Median line straight or slightly arcuate with short and robust terminal fissures. Axial area narrow, slightly enlarged in the middle; central area orbicular. Striæ robust, radiate, punctate, in the middle part of the valve alternately longer and shorter, 7 to 10 in 0.01 mm. Striæ at the base of the valve not reaching the ends. In the middle part of the valve the striæ form irregular longitudinal rows. The most peculiar character of this curious species is the spines along the margin from both sides of the valve. Spines are regular, about 3.5 to 5 in 0.01 mm. *Didymosphenia dentata* is only reported from Baikal Lake. Common.

DIDYMOSPHENIA DENTATA Dorogostaisky var. SUBCAPITATA Skv. and Meyer. Plate 14, fig. 15.

Didymosphenia dentata Dor. var. *subcapitata* Skv. and Meyer and fo. *curta* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 32, pl. 3, figs. 141, 142.

Differs from the type in its short not capitate apex. Length, 0.051 to 0.099 mm; breadth, 0.029 to 0.041. Striæ 6.5 in 0.01 mm. Common with the type.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. Plate 3, figs. 3, 10, and 12.

Gomphonema geminatum Lyngb. var. *sibirica* GRUNOW, Algen und Diatomaceen aus dem Kaspischen Meere (1876) 11.

Gomphonema geminatum Lyngb. var. *hybrida* GRUNOW, Diatomeen von Franz Josefs-Land (1884) 97, pl. 1, fig. 11.

Didymosphenia sibirica (Grun.) M. Schmidt, A. SCHMIDT, Atlas der Diatom. (1899) pl. 214, figs. 1–3.

Didymosphenia geminata var. *sibirica* Grun. fo. *genuina* SKV. and MEYER, pl. 2, fig. 129; fo. *elongata* SKV. and MEYER, pl. 2, fig. 130; fo. *curta* SKV. and MEYER, pl. 2, fig. 131; var. *Dorogostaisky* SKV. and MEYER, pl. 2, fig. 127; fo. *curta*, pl. 2, fig. 128 in SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 30–31.

Valve lanceolate-clavate, convex in the middle part, slightly attenuate to the upper and the lower parts. Ends broad-rounded. Length, 0.068 to 0.21 mm; breadth, 0.032 to 0.051. Median line straight or slightly curved, enlarged in the middle part, with distinct, large, comma-shaped, terminal fissures. Terminal area (nodule) at the upper part distinct, axial area narrow-linear, suddenly dilated around the central nodule to an orbicular space. At one side of the central nodule are 1 to 5 large isolated puncta or stigmata, disposed in a longitudinal row. Striæ radiate at the ends, in the middle alternately longer and shorter, punctate, 6 to 7 in 0.01 mm. A variable diatom very common in Baikal and known from Kossogol Lake, from Okhotsk, the mouth of Yenisei River, from Kamchatka, from Franz Josef Land, and from Neogene deposits in Saga Prefecture, Kiushiu Island, Nippon.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. SUBCAPITATA fo. nov. Plate 3, fig. 6.

Didymosphenia geminata var. *genuina* Skv. and Meyer fo. *baicalensis* SKVORTZOW and MEYER, pl. 2, fig. 120; fo. *curta* SKVORTZOW and MEYER, pl. 2, fig. 121, Contribution to the diatoms of Baikal Lake (1928) 30.

Differs from variety *sibirica* Grun. in having a subcapitate apex. Length, 0.085 to 0.127 mm; breadth, 0.04 to 0.042. Isolated puncta 1 to 3. Striæ 7 to 7.5 in 0.01 mm. Very common in Baikal.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. CURVATA fo. nov. Plate 14, figs. 8, and 20.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *curvata* SKV. and MEYER, pl. 3, fig. 137; fo. *elongata* SKV. and MEYER, pl. 3, fig. 138; fo. *curta* SKV. and MEYER, pl. 2, figs. 132–134, Contribution to the diatoms of Baikal Lake (1928) 31.

Differs from the type in having slightly curvate valves. Length, 0.037 to 0.153 mm; breadth, 0.027 to 0.049. Median line slightly arcuate. Isolated puncta 1 to 2. Striæ 8 to 11 in 0.01 mm. Very common in Baikal Lake. Recently reported in Neogene deposits in Saga Prefecture, Kiushiu Island, Nippon.

DIDYMOSPHENA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. ANOMALA Skv. and Meyer.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *anomala* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 31, pl. 2, fig. 135.

Differs from the type in having one stigma on one side of the central nodule and two others on the other side. Length,

0.21 mm; breadth, 0.044. Striæ 7 in 0.01 mm. A form not recorded from Olhon Gate.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt. Plate 4, figs. 14 and 15; Plate 10, fig. 13; Plate 14, fig. 7.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt, A. SCHMIDT, Atlas Diatom. (1899) pl. 214, figs. 11, 12.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt fo. *baicalensis* SKV. and MEYER, pl. 2, fig. 136; var. *baicalensis* SKV. and MEYER, pl. 2, fig. 122; fo. *curta* SKV. and MEYER, pl. 2, fig. 124; fo. *elongata* SKV. and MEYER, pl. 2, fig. 126; SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 31.

Valve clavate-lanceolate, convex in the middle with subcapitate apex, broader than the end. Length, 0.072 to 0.167 mm; breadth, 0.032 to 0.056. Stigmata 2 to 7. Striæ 8 in 0.01 mm. A variable diatom, common in Baikal and reported from Ladoga and Onega Lakes, northern Europe.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt fo. CURVATA fo. nov.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *baicalensis* Skv. and Meyer fo. *curvata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 30, pl. 2, fig. 123.

Differs from the type in its slightly curved valve with arcuate median line. Length, 0.072 mm; breadth, 0.034. Stigmata 2. Striæ 8 in 0.01 mm. Rare.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt fo. CAPITATA Skv. and Meyer.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt fo. *capita* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 30, pl. 2, fig. 125.

Differs from the type in its capitate apex and narrow middle part. Length, 0.222 mm; breadth, 0.048. Stigmata 5. Striæ 7 in 0.01 mm. Rare.

GOMPHONEMA QUADRIPUNCTATUM (Oestr.) Wisl. Plate 14, figs. 13, 16, and 18.

Gomphonema olivaceum Kütz. var. *quadripunctata* OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckes in der nordwestlichen Mongolei. Hedwigia 48 (1909) pl. fig. 11.

Gomphonema quadripunctatum (Oestrup) WISLOUCH, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-Sees (1924) 166, 167, fig. 6.

Gomphonema quadripunctatum (Oestrup) Wisl. var. *genuina* SKV. and MEYER, pl. 2, fig. 96; fo. *tumida* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 27.

Valve clavate-lanceolate, concave in the middle, long-attenuate to the ends. Length, 0.045 to 0.074 mm; breadth, 0.008 to

0.015. Median line straight, filiform with a distinct straight terminal fissure. Axial area narrow; central area broad, orbicular with four distinct puncta or stigmata on both sides of central nodules. Striæ radiate, lineate, 14 to 18 in 0.01 mm. Common in Baikal; known from Kossogol Lake of northern Mongolia and Onega Lake of northern Europe.

GOMPHONEMA QUADRIPUNCTATUM (Oestr.) Wisl. var. HASTATA Wisl. Plate 14, fig. 17?

Gomphonema quadripunctatum (Oestr.) Wisl. var. *hastata* WISLOUCH, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees (1924) 166–167, figs. *a–c*.

Gomphonema quadripunctatum (Oestr.) Wisl. var. *genuina* Skv. and Meyer fo. *robusta* SKV. and MEYER, pl. 2, fig. 97; var. *hastata* Wisl. fo. *curta* SKVORTZOW and MEYER, pl. 2, fig. 101, Contribution to the diatoms of Baikal Lake (1928) 27.

Differs from the type in its rhombic-elliptic valves, with broad-rounded apex and subacute base. Length, 0.034 to 0.061 mm; breadth, 0.01 to 0.017. Striæ 14 to 15 in 0.01 mm. Apex with a distinct, transverse, round, marginal, siliceous rib. In some valves this rib is absent. Very common in Baikal Lake. Reported by me from Imengol River, near Hailar, western Manchuria, and from Kizaki Lake, Nippon.

GOMPHONEMA INNATA sp. nov. Plate 14, fig. 2.

Gomphoneis elegans Grun. var. *quadripunctata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 29, pl. 2, figs. 115, 116.

Valve clavate, lanceolate, tapering from the middle towards the obtuse ends. Length, 0.052 mm; breadth, 0.013. Median line straight with distinct terminal fissures. Axial area narrow; central area orbicular. Costæ radiate, robust, compact, not lineate or punctate, 12 in 0.01 mm. Central area with 4 stigmata. Differs from *G. quadripunctatum* (Oestr.) Wisl. in its robust, not lineate, striæ; from *Gomphoneis elegans* Grun. in the absence of longitudinal lines and punctate costæ. A distinct, robust species. Uncommon in Baikal.

GOMPHONEMA IRRATA sp. nov. var. ELEGANS var. nov. Plate 14, fig. 1.

Differs from the type in the long-lanceolate valve with attenuate rounded apex and subcapitate end. Length, 0.107 mm; breadth, 0.02. Costæ in the middle 10, at the ends 12, in 0.01 mm, not lineate. Central area with 10 stigmata. Rare.

GOMPHONEMA OLIVACEUM (Lyngb.) Kütz. Plate 14, fig. 21.

Gomphonema olivaceum (Lyngb.) Kütz., A. SCHMIDT, Atlas Diatom. (1902) pl. 233, figs. 9–16.

Valve lanceolate, scarcely clavate, tapering from the middle towards the obtuse ends. Length, 0.042 mm; breadth, 0.01. Median line filiform with distinct terminal fissures. Axial area narrow; central area broad. Costæ distinctly compact and not lineate, radiate throughout and of unequal length in the middle part, 11 in 0.01 mm. No stigma below the central nodule. Rare.

GOMPHONEMA INTRICATUM Kütz. var. PUMILA Grun. Plate 14, fig. 6.

Gomphonema intricatum Kütz. var. *pumila* Grun., VAN HEURCK, Synopsis (1880) pl. 24, figs. 35, 36.

Valve sublinear with attenuate subacute ends. Length, 0.035 mm; breadth, 0.042. Axial area narrow; central area transverse and broad. Striæ subparallel, obscurely punctate, 10 to 11 in 0.01 mm. Isolated puncta distinct. Uncommon.

GOMPHONEMA INTRICATUM Kütz. var. MINOR var. nov. Plate 14, figs. 3 and 14.

Smaller than variety *pumila* Grun. Length, 0.012 to 0.018 mm; breadth, 0.0025 to 0.0034. Striæ 12 in 0.01 mm. Isolated puncta distinct. Striæ in the middle part not so distinctly interrupted. Infrequent.

GOMPHONEMA VENTRICOSUM Greg. Plate 14, figs. 5, 11, 22, and 24.

Gomphonema ventricosum Greg., VAN HEURCK, Synopsis (1880) pl. 25, fig. 13.

Valve clavate with broad middle part and attenuate ends. Apex subacute and the ends subcapitate. Length, 0.02 to 0.056 mm; breadth, 0.0085 to 0.013. Median line straight with distinct, long, terminal fissures and a comma-shaped transverse fissure near the central pores. Axial area narrow; central area orbicular. Striæ radiate, punctate, 9 to 16 in 0.01 mm. A variable diatom, very common in Baikal Lake. Known from Scotland, Norway, Sweden, Finland, Yenisei River, Kamchatka, and Onega Lake of northern Europe. According to Wislouch and Kolbe *G. ventricosum* can be regarded as a relict of glacial times.

GOMPHONEMA FIRMA sp. nov. Plate 10, fig. 12.

Gomphoneis herculeanum Ehrenb., SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 28, pl. 2, fig. 106.

Valve lanceolate, clavate, gradually tapering from the middle to the obtuse apex and base. The latter is broader than the apex. Length, 0.125 mm; breadth, 0.02. Median line with distinct, long, terminal fissures and comma-shaped fissures near the central pores. Axial area linear-lanceolate, covered with indis-

tinct irregular puncta; central area broad with a stigma. Striæ robust, coarsely punctate, subparallel or slightly radiate, 9 in the middle, 10 to 11 at the ends, in 0.01 mm. A species closely related to *G. ventricosum* Greg. Uncommon.

GOMPHONEMA DELICATULA sp. nov. Plate 14, fig. 4.

Gomphonema eriense Grun. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 29, pl. 2, fig. 114.

Valve lanceolate and very slightly clavate, broad in the middle part, tapering to the subacute ends. Length, 0.061 to 0.07 mm; breadth, 0.012 to 0.013. Median line filiform with distinct terminal fissures. Axial area narrow, central area slightly broader. Striæ radiate, fine-punctate, longer and shorter in the middle part, 14 to 15 in 0.01 mm, with a distinct stigma between the central pores. A new species not closely connected with *G. ventricosum* Ehr. Rare.

GOMPHONEMA DELICATULA sp. nov. var. **BIPUNCTATA** var. nov. Plate 14, fig. 19.

Valve lanceolate with subcapitate apex and long-attenuate ends. Length, 0.068 mm; breadth, 0.014. Striæ fine-punctate, 13 in 0.01 mm. Central area with 2 stigmata. Differs from the type in the capitate apex and the presence of 2 stigmata. This form is connected with *G. ventricosum* Ehr. and var. *ornata* Grun.

GOMPHONEMA LANCEOLATUM Ehr. Plate 14, figs. 12 and 25.

Gomphonema lanceolatum Ehr., A. SCHMIDT, Atlas Diatom. (1902) pl. 235, figs. 26, 27.

Valve clavate, gradually tapering from the middle to the obtuse apex and base. Length, 0.073 to 0.083 mm; breadth, 0.01 to 0.012. Axial area linear, somewhat enlarged in the middle part; central area suborbicular with one isolated stigma. Striæ coarsely punctate, 10 to 12 in 0.01 mm. Very common in Baikal.

GOMPHONEMA LANCEOLATUM Ehr. var. **CAPITATA** var. nov. Plate 14, fig. 26.

Differs from the type in its broad capitate apex. Length, 0.09 mm; breadth, 0.014. Striæ coarsely punctate, 8 in 0.01 mm. Rare.

EPITHEMIA TURGIDA (Ehr.) Kütz. var. **GRANULATA** (Ehr.) Grun. Plate 10, fig. 15.

Epithemia turgida (Ehr.) Kütz. var. *granulata* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 387, fig. 734.

Valve with arcuate dorsal and constricted ventral margins. Length, 0.069 mm; breadth, 0.012. Costæ 4 in 0.01 mm. Striæ 1 to 3 between costæ. Common.

EPITHEMIA ZEBRA (Ehr.) Kütz. Plate 10, fig. 9.

Epithemia zebra (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 384–385, fig. 729.

Valve linear-lanceolate with arcuate dorsal and slightly convex ventral margins. Length, 0.049 mm; breadth, 0.0085. Costæ 3, alveoli 12 to 14, in 0.01 mm. Infrequent.

EPITHEMIA INTERMEDIA Fricke. Plate 11, fig. 8.

Epithemia intermedia Fricke, FR. HUSTEDT, Bacillar. (1930) 387, fig. 732.

Valve with arcuate dorsal and almost ventral margins. Ends obtuse. Length, 0.032 mm; breadth, 0.012. Costæ 4, striæ 12, in 0.01 mm. Rare. Known from European lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll. Plate 11, fig. 7.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Valve linear, arcuate on the dorsal, straight on the ventral side, reflexed at the extremities. Length, 0.078 mm; breadth, 0.02. Costæ 7 to 8, striæ about 15, in 0.01 mm. Very rare.

RHOPALODIA GIBBA (Ehr.) O. Müll. var. **MONGOLICA** Oestrup. Plate 11, fig. 14.

Rhopalodia gibba (Ehr.) O. Müll. var. *mongolica* OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlischen Mongolei (1909) 86, pl. fig. 12.

Differs from var. *ventricosa* in its more lunate valves. Length, 0.042 mm; breadth, 0.02. Costæ 7, striæ 15, in 0.01 mm. Rare. Known from Kossogol Lake.

Genus NITZSCHIA Hassall

NITZSCHIA ANGUSTATA (W. Smith) Grun. Plate 11, figs. 13 and 19.

Nitzschia angustata (W. Smith.) Grun., FR. HUSTEDT, Bacillar. (1930) 402, fig. 767.

Valve linear-lanceolate with parallel margins and abruptly attenuate ends. Length, 0.025 to 0.027 mm; breadth, 0.005 to 0.0052. Striæ 16 in 0.01 mm. Uncommon.

GRUNOWIÆ (RABH.) GRUNOW

NITZSCHIA DENTICULATA Grun. var. **BAIKALENSIS** var. nov. Plate 1, fig. 20.

Differs from the type in its subcapitate ends. Length, 0.12 mm; breadth, 0.006. Keel puncta 8, striæ 30, in 0.01 mm. Rare.

DISSIPATÆ GRUNOW

NITZSCHIA DISSIPATA (Kütz.) Grun. Plate 10, fig. 11.

Nitzschia dissipata (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 412, fig. 789.

Valve linear-lanceolate with attenuate ends. Length, 0.064 mm; breadth, 0.0068. Keel puncta 7 in 0.01 mm. Striæ indistinct. Rare.

NITZSCHIA ACUTA Hantzsch. Plate 1, fig. 21.

Nitzschia acuta Hantz., FR. HUSTEDT, Bacillar. (1930) 412, fig. 790.

Valve narrow-lanceolate with long-attenuate, subcapitate ends. Length, 0.109 mm; breadth, 0.005. Keel puncta 6 to 7 in 0.01 mm. Striæ indistinct. Infrequent.

LANCEOLATÆ GRUNOW

NITZSCHIA CAPITELLATA Hust. Plate 11, fig. 4.

Nitzschia capitellata HUSTEDT, Bacillar. (1930) 414, fig. 792.

Valve lanceolate with abruptly attenuate and capitate ends. Length, 0.047 mm; breadth, 0.005. Keel puncta 15, striæ about 35, in 0.01 mm. Differs from the type in its coarser striæ. Infrequent.

NITZSCHIA GRACILIS Hantzsch. Plate 1, fig. 19.

Nitzschia gracilis Hantzsch., A. SCHMIDT, Atlas Diatom. (1924) pl. 349, figs. 34–37.

Valve linear-lanceolate with attenuate ends. Length, 0.069 to 0.076 mm; breadth, 0.0034. Keel puncta 15, striæ about 35, in 0.01 mm. Infrequent.

NITZSCHIA BAIKALENSIS sp. nov. Plate 3, fig. 8.

Valve narrow lanceolate, gradually tapering to obtuse ends. Length 0.025 to 0.032 mm; breadth, 0.0029. Keel puncta 12 to 16 in 0.01 mm. Striæ indistinct. A species related to *N. fonticola* Grun. Infrequent.

NITZSCHIA FONTICOLA Grun. Plate 1, figs. 17 and 18.

Valve lanceolate, convex in the middle part and attenuate at the ends. Length, 0.01 to 0.012 mm; breadth, 0.0025 to 0.0034. Keel puncta 15 to 18 in 0.01 mm. Striæ indistinct. Differs from the type in its indistinct striæ. Uncommon.

SIGMOIDEÆ (GRUNOW) HUSTEDT

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith.

Nitzschia sigmoidea (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 419, fig. 810.

Frustule very large, sigmoid with broad ends. Uncommon.

CYMATOPLEURA SOLEA (Breb.) W. Smith. Plate 15, figs. 4 and 5; Plate 16, fig. 2; Plate 17, fig. 13.

Cymatopleura solea (Breb.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 425, fig. 823*a*; A. SCHMIDT, Atlas Diatom. (1911) pl. 276, figs. 2, 3.

Valve linear-lanceolate, constricted in the middle. Length, 0.096 to 0.127 mm; breadth, 0.022. Costæ 7 to 8 in 0.01 mm. Infrequent.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. APICULATA (W. Smith) Grun. Plate 17, fig. 12.

Cymatopleura solea (Breb.) W. Smith var. *apiculata* (W. Smith) Grun., A. SCHMIDT, Atlas Diatom. (1911) pl. 276, fig. 1, 1*a*.

Differs from the type in its apiculate ends. Rare.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith var. CONSTRICTA Grun. Plate 18, fig. 10.

Cymatopleura elliptica (Breb.) W. Smith var. *constricta* Grun., FR. HUSTEDT, Bacillar. (1930) 428, fig. 826.

Valve broad, elliptic-linear, slightly constricted in the middle. Long diameter, 0.102 mm; short diameter, 0.047. Costæ 3, striæ 18, in 0.01 mm. Uncommon. Known from alpine lakes.

CYMATOPLEURA ANGULATA Grev. Plate 18, fig. 6.

Cymatopleura angulata Grev., FR. HUSTEDT, Bacillar. (1930) 426, fig. 824.

Valve elliptic-linear with apiculate ends. Long diameter, 0.093 mm; short diameter, 0.035. Costæ 3.5, striæ 18, in 0.01 mm. Rare.

SURIRELLA LINEARIS W. Smith. Plate 17, fig. 11.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar (1930) 434, figs. 837, 838.

Valve linear-lanceolate with subacute ends. Long diameter, 0.081 mm; short diameter, 0.015. Costæ 2.5 in 0.01 mm. Rare.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister? Plate 16, fig. 13.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister ?, FR. HUSTEDT, Bacillar. (1930) 434, fig. 840.

Valve elliptic-lanceolate with distinct marginal alæ and costæ of 1.5 to 2 in 0.01 mm, reaching the median area. Intercostal striæ 18 in 0.01 mm. The median area forms a longitudinal line of closely set transverse lines. Long diameter, 0.115 mm; short diameter, 0.037. Our specimens recall *S. turgida* var. *lanceolata* Wislouch and Kolbe from Onega Lake, northern Russia.[23]

SURIRELLA BISERIATA Breb. var. BIFRONS (Ehr.) Hust. fo. PUNCTATA Meister. Plate 15, fig. 7; Plate 17, fig. 1.

Surirella biseriata Breb. var. *punctata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 41, pl. 3, fig. 186.

[23] Wislouch and Kolbe, New diatoms from Russia (1916) 264, pl. 3, fig. 4.

Valve elliptic with acute end. Marginal alæ robust. Costæ 2 in 0.01 mm, reaching the central area. The surface of the valve is covered with distinct scattered beads. Long diameter, 0.085 to 0.102 mm; short diameter, 0.039 to 0.044. Common.

SURIRELLA GRANULATA Oestrup. Plate 16, fig. 12.

Surirella granulata OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei (1909) 91, fig. 17.

Valve linear-lanceolate or elliptic-linear. Costæ marginal, not reaching the center, 2.5 in 0.01 mm. All the surface of the valve is covered with beads. Long diameter, 0.054 mm; short diameter, 0.014. Differs from the type in having no longitudinal line in the center of the valve. The type is known from Kossogol Lake.

SURIRELLA TURGIDA W. Smith fo. BAIKALENSIS fo. nov. Plate 16, fig. 10.

Valve broad, elliptic with acute ends. Marginal alæ robust. Costæ dilated at the margin and attenuate towards the ends, 2.5 in 0.01 mm. Striæ between costæ very fine. Long diameter, 0.061 mm; short diameter, 0.034. Around the central area are two longitudinal rows of beads. Differs from the type in its more elliptic valve and beads distributed in longitudinal lines. Rare.

SURIRELLA MARGARITIFERA Hust. Plate 16, fig. 5; Plate 17, fig. 2.

Surirella margaritifera Hustedt, A. SCHMIDT, Atlas Diatom. (1922) pl. 354, fig. 8.

Valve elliptic-lanceolate with subacute ends. Costæ distinct, 2 in 0.01 mm, reaching an indistinct central area. The valve is covered with spines and longitudinal and radiate striæ 18 in 0.01 mm. Striæ consist of irregular puncta. The type is known from Tanganyika Lake, Africa.

SURIRELLA GRACILIS (W. Smith) Grun. Plate 17, fig. 5.

Surirella gracilis (W. Smith) Grun., FR. HUSTEDT, Bacillar. (1930) 435, fig. 843.

Valve linear-lanceolate with parallel margins and subacute ends. Costæ 5, striæ 20, in 0.01 mm. Long diameter, 0.127 mm; short diameter, 0.027. Rare.

SURIRELLA DIDYMA Kütz. var. MINOR var. nov. Plate 16, fig. 8.

Valve constricted in the middle, with subacute ends. Costæ marginal, 2.5 in 0.01 mm. Long diameter, 0.042 mm; short diameter, 0.01. No longitudinal line in the middle part of the

valve. Differs from the type in the absence of a longitudinal line in the middle part of the valve. Infrequent.

SURIRELLA NYASSÆ O. Müll. var. BAIKALENSIS var. nov. Plate 15, fig. 3; Plate 16, fig. 6.

Valve long, linear-lanceolate, constricted in the middle part with broad apiculate ends. Costæ very distinct, 4 to 4.5 in 0.01 mm, reaching the median line. Intercostal striæ 15 to 16 in 0.01 mm. Long diameter, 0.055 to 0.088 mm; short diameter in the middle of the valve, 0.011 to 0.033, and at the enlarged ends, 0.017. The type specimens are 0.343 to 0.433 mm in length and 0.047 to 0.080 mm in breadth, and are recorded from plankton of Nyassa Lake, Africa.[24]

SURIRELLA ACUMINATA Hust. var. BAIKALENSIS var. nov. Plate 3, fig. 7; Plate 17, fig. 4.

Valve linear-lanceolate, strongly constricted in the middle, and with long apiculate ends. Outer rim narrow, finely crossbarred. Marginal alæ robust. Costæ dilated at the margin and attenuate towards the pseudoraphe, 1.5 to 2 in 0.01 mm. Intercostal striæ 12 to 15 in 0.01 mm. Differs from *S. acuminata* Hustedt, reported from Tanganyika Lake, Africa, in its more robust costæ and in having no longitudinal line in the middle part of the central area.[25]

SURIRELLA PREHENSILIS sp. nov. Plate 17, fig. 7.

Valve elliptic-lanceolate with acute ends and somewhat curved lower part. Marginal alæ robust. Costæ distinct, 2 in 0.01 mm, reaching linear-lanceolate central area, covered with puncta, beads, and little spines. Intercostal lineate striæ are distinct. A species akin to *S. curvifacies* J. Brun, of sea waters.[26]

SURIRELLA OÖPHORA sp. nov. Plate 15, fig. 1.

Surirella ovalis Breb. var. *baikalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 42, pl. 3, fig. 177.

Valve oval with one end much broader than the other. Costæ robust, radiate, about 1 in 0.01 mm, running two-thirds of the way to the center. Marginal alæ robust. Intercostal striæ fine, 22 to 24 in 0.01 mm. Long diameter, 0.124 mm; short diameter, 0.068 to 0.079. Little spines irregularly along the costæ ends

[24] Müller, Bacillariaceen aus dem Nyassalande und einigen benachb. Gebieten aus Beiträge zur Flora von Africa (1904) xxv, 33, pl. 2, fig. 3.

[25] Schmidt, Atlas Diatom. (1922) pl. 355, figs. 5, 6.

[26] Schmidt, op. cit. (1925) pl. 362, fig. 1.

are distinct. Central area lanceolate and distinctly lineate. A distinct species, common in Baikal.

SURIRELLA UNINODES sp. nov. Plate 16, fig. 3.

Valve broad oval with one end much broader than the other. End broad-rounded, spirally curved. Outer rim very distinct. Marginal alæ robust with broad curved costæ, 1 to 1.5 in 0.01 mm, radiating to the central area. Between the costæ are fine, punctate, long lines, and a series of spines. Lines 15 in 0.01 mm. A distinct species, akin to *S. spiralis* Kütz.

SURIRELLA UNIDENTATA sp. nov. Plate 17, fig. 3.

Valve broad-elliptic with broad rounded end, and with one large spine in the upper part of the central area. Outer rim distinct. Marginal rib of the costæ robust. Costæ strong, 1 in 0.01 mm, running to the center. Between the costæ are beads or spines. A distinct species seen several times.

SURIRELLA CONIFERA sp. nov. Plate 16, fig. 1.

Valve ovate with slightly acute ends. Outer rim narrow. Marginal alæ not robust. Costæ marginal, 2 in 0.01 mm. All the surface of the valve is covered with radiating, fine, irregular, interrupted striæ. Long diameter, 0.147 mm; short diameter, 0.08. A species not allied to any other. Infrequent.

SURIRELLA CONIFERA sp. nov. var. **PUNCTATA** var. nov. Plate 16, fig 4.

Differs from the type in the valve being covered with nonradiate puncta. Costæ 2 in 0.01 mm. Long diameter, 0.111 mm; short diameter, 0.076. Rare.

SURIRELLA LACUS BAIKALI sp. nov. Plate 15, fig. 2.

Valve broad-elliptic with acute ends. Valve surface separated into two areas; the outer with distinct costæ, and the inner area with a diameter of a little over one-half that of the valve. Outer rim distinctly crossbarred with costæ. Marginal alæ indistinct. Costæ fine, about 1.5 in 0.01 mm, running radiately halfway to the center. Between costæ lines of longitudinal striæ, and longitudinal lines of irregular dark beadings or blotches. The inner or central area separated by a longitudinal line, covered with dark beading. A distinct, variable species, common in Baikal.

SURIRELLA LACUS BAIKALI sp. nov. var. **MARGINATA** var. nov. Plate 15, fig. 8; Plate 16, fig. 9.

Surirella Fulleborni O. Müll. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 41, pl. 3, fig. 175.

Valve elliptical with distinct, dark marginal costæ of 2 to 2.5 in 0.01 mm. Valve surface covered with fine radiating lines without beads. Long diameter, 0.237 mm; short diameter, 0.127. very common in Baikal.

SURIRELLA LACUS BAIKALI sp. nov. var. PUNCTATA var. nov. Plate 16, fig. 11.

Differs from variety *marginata* in having no dark marginal costal rib. All the surface is covered with fine puncta. Long diameter, 0.238 mm; short diameter, 0.119. Costæ 2 in 0.01 mm. Infrequent.

SURIRELLA LACUS BAIKALI sp. nov. var. PARADOXA var. nov. Plate 15, fig. 9.

Valve elliptic-lanceolate with attenuate and subacute ends. Border consists of an outer narrow row and large subcircular alæ. Costæ distinct, 1 to 1.5 in 0.01 mm, dilated at the margin, attenuate towards the central area. Between costæ are distinct lines of striæ about 12 to 13 in 0.01 mm, and intermediate longitudinal lines of irregular beadings or blotches, covering the whole central area of elliptic shape. Long diameter, 0.12 mm; short diameter, 0.064.

SURIRELLA PAUCIDENS sp. nov. Plate 15, fig. 6.

Valve elliptic with subacute ends. Outer rim narrow and distinct. Marginal alæ fine and regular, costæ radiate, reaching the center. Intercostal striæ fine, 18 to 22 in 0.01 mm. Long diameter, 0.185 to 0.238 mm; short diameter, 0.083 to 0.086. A species not akin to others. Common.

SURIRELLA PAUCIDENS sp. nov. var. PUNCTATA var. nov. Plate 17, figs. 8 and 14.

Differs from the type in the presence of a long line in the middle part of the valve and distinct punctate striæ. Long diameter, 0.187 mm; short diameter, 0.08. Differs from *S. biseriata* Breb. and *S. lancettula* Hust. in its more numerous costæ. The last diatom is reported from Tanganyika Lake.

CAMPYLODISCUS LACUS BAIKALI sp. nov. Plate 17, fig. 9.

Valve circular or slightly bent with distinct band or rim. Costæ strong, running about to the center, 40 in number, 1 to 1⅓ in 0.01 mm. Between the costæ are fine, closely set parallel lines, 21 to 22 in 0.01 mm. Central area linear, indistinct. No puncta or beads. Diameter, 0.085 to 0.093 mm. Differs from *C. noricus* Ehr. in its linear and not quadrate or orbicular central area. Common.

CAMPYLODISCUS LACUS BAIKALI sp. nov. var. HISPIDULA var. nov. Plate 18, fig. 8.

Valve subcircular with distinct rib and radiate costæ reaching the elongate median area. Costæ 1 to 1.5 in 0.01 mm. Striæ

very fine with irregular small beads. Diameter, 0.136 to 0.153 mm. Differs from the type in the presence of small beads.

CAMPYLODISCUS LACUS BAIKALI sp. nov. var. ANNULATA var. nov. Plate 17, fig. 10.

Valve circular with a narrow, distinct, finely crossbarred outer rim and robust costæ, 2 in 0.01 mm, running radially three-fourths of the way to the center. Striæ 20 in 0.01 mm. Linear-elliptic central portion of the valve covered with parallel lines of striæ and small puncta. Diameter, 0.119 to 0.125 mm. Differs from the type in its linear-elliptic central portion. Common.

CAMPYLODISCUS RUTILUS sp. nov. Plate 16, fig. 7; Plate 17, fig. 6.

Valve very dark in color, circular or semicircular with distinct marginal rib and robust costæ about 1 in 0.01 mm, reaching the median line. Between the costæ are lines and irregular dots of red-brown color. Diameter, 0.136 to 0.17 mm. One of the largest and most robust *Campylodiscus* species in Baikal. Differs from all other Baikal species of the genus in its robust costæ and distinct structure.

CAMPYLODISCUS FRAGILIS sp. nov. Plate 18, figs. 2, 4, 5, 7, and 9.

Valve circular, sometimes strongly curved on one or both sides with narrow marginal rib. Fine radiate costæ reach the central area. Costæ 3 in 0.01 mm, covered with beads, forming regular longitudinal rows, and at the same time between costæ are double lines of irregular puncta, reaching the central part of the valve. Diameter, 0.06 to 0.07 mm. A distinct and variable species. Common.

CAMPYLODISCUS FRAGILIS sp. nov. var. PUNCTATA var. nov. Plate 18, fig. 1.

Valve curved, beaded and punctate. Puncta irregular and not in rows. Costæ 2, beads 5 to 6, in 0.01 mm. Diameter, 0.085 to 0.09 mm.

CAMPYLODISCUS FRAGILIS sp. nov. var. RIGENS var. nov. Plate 18, figs. 11 and 12.

Valve circular, strongly bent with a narrow outer rim and robust costæ 2.5 to 3 in 0.01 mm, running radially to the center. Between the costæ are robust, irregular beads, disposed in longitudinal rows. Diameter 0.1 to 0.105 mm. A very distinct and robust form. Very common.

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ILLUSTRATIONS

[Drawings by the author, made with E. Leitz Apochromat 2 mm and compens ocular 4]

PLATE 1

FIG. 1. *Melosira baikalensis* (K. Meyer) Wisl., frustules with mature cell wall.
2. *Melosira baikalensis* (K. Meyer) Wisl., frustules with mature cell wall.
3. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
4. *Melosira baikalensis* (K. Meyer) Wisl., polymorphism in frustules, the lower frustule is matured, the upper is formed.
5. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
6. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
7. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
8. *Melosira baikalensis* (K. Meyer) Wisl. fo. *oblonga-punctata* Skv. and Meyer.
9. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
10. *Melosira baikalensis* (K. Meyer) Wisl., auxospore.
11. *Melosira baikalensis* (K. Meyer) Wisl., frustule 0.03 mm in breadth.
12. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
13. *Fragilaria spinosa* sp. nov.
14. *Melosira arenaria* Moore var. *baikalensis* var. nov. fo. *ornata* fo. nov.
15. *Melosira arenaria* Moore var. *baikalensis* var. nov.
16. *Melosira arenaria* Moore.
17. *Nitzschia fonticola* Grun.
18. *Nitzschia fonticola* Grun.
19. *Nitzschia gracilis* Hantz.
20. *Nitzschia denticulata* Grun. var. *baikalensis* var. nov.
21. *Nitzschia acuta* Hantz.
22. *Melosira arenaria* Moore var. *baikalensis* var. nov. fo. *punctata* fo. nov.
23. *Melosira arenaria* Moore var. *baikalensis* var. nov.
24. *Melosira Binderana* Kütz.
25. *Melosira Binderana* Kütz.
26. *Melosira arenaria* Moore.
27. *Fragilaria spinosa* sp. nov.
28. *Melosira arenaria* Moore var. *baikalensis* var. nov.

PLATE 2

FIG. 1. *Stephanodiscus Hantzschii* Grun.
2. *Stephanodiscus Hantzschii* Grun.
3. *Stephanodiscus astræa* (Ehr.) Grun. var. *minutula* (Kütz.) Grun.
4. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.

FIG. 5. *Stephanodiscus Hantzschii* Grun.
6. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.
7. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.
8. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
9. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
10. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov.
11. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
12. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
13. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
14. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov.
15. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov.
16. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
17. *Coscinodiscus radiatus* Ehr.
18. *Coscinodiscus radiatus* Ehr.
19. *Cymbella cuspidata* Kütz.
20. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.

PLATE 3

FIG. 1. *Cyclotella baikalensis* Skv. and Meyer fo. *stellata* fo. nov.
2. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.
3. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun.
4. *Cyclotella baikalensis* Skv. and Meyer fo. *stellata* fo. nov.
5. *Cyclotella baikalensis* Skv. and Meyer fo. *stellata* fo. nov.
6. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *subcapitata* fo. nov.
7. *Surirella acuminata* Hust. var. *baikalensis* var. nov.
8. *Nitzschia baikalensis* sp. nov.
9. *Cymbella cistula* (Hemp.) Grun. var. *arctica* Lagerst.
10. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun.
11. *Cyclotella baikalensis* Skv. and Meyer, from the frustule view.
12. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun.

PLATE 4

FIG. 1. *Synedra Vaucheriæ* Kütz. var. *capitellata* Grun.
2. *Eunotia Lacus Baikali* sp. nov.
3. *Eunotia prærupta* Ehr.
4. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
5. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
6. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
7. *Tabellaria fenestrata* (Lyngb.) Kütz.
8. *Eunotia Clevei* Grun.
9. *Eunotia Clevei* Grun. var. *hispida* var. nov.
10. *Eunotia prærupta* Ehr. var. *inflata* Grun.
11. *Eunotia prærupta* Ehr. var. *inflata* Grun.
12. *Tetracyclus lacustris* Ralfs.
13. *Fragilaria spinosa* sp. nov.
14. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
15. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.

FIG. 16. *Opephora Martyi* Herib.
17. *Eunotia submonodon* Hust.
18. *Eunotia Clevei* Grun. var. *hispida* var. nov.
19. *Fragilaria spinosa* sp. nov.

PLATE 5

FIG. 1. *Achnanthes Meyeri* sp. nov.
2. *Achnanthes Meyeri* sp. nov.
3. *Achnanthes profunda* sp. nov.
4. *Achnanthes calcar* Cleve.
5. *Cocconeis placentula* (Ehr.) var. *baikalensis* var. nov.?
6. *Synedra rumpens* Kütz.
7. *Cocconeis placentula* (Ehr.) var. *baikalensis* var. nov.
8. *Cocconeis placentula* (Ehr.) var. *baikalensis* var. nov.
9. *Achnanthes Oestrupii* (A. Cleve) Hust.
10. *Achnanthes Oestrupii* (A. Cleve) Hust.
11. *Achnanthes striata* Skv. and Meyer.
12. *Achnanthes striata* Skv. and Meyer.
13. *Achnanthes lanceolata* Breb.
14. *Achnanthes lanceolata* Breb. var. *elliptica* Cleve.
15. *Achnanthes Peragallii* Brun and Herib.
16. *Achnanthes Lacus Baikali* sp. nov.
17. *Navicula torneensis* Cleve var. *aboensis* Cleve.
18. *Achnanthes lanceolata* Breb. var. *rostrata* Hust.
19. *Achnanthes lanceolata* Breb.
20. *Achnanthes Oestrupii* (A. Cleve) Hust.
21. *Achnanthes Clevei* Grun. var. *rostrata* Hust.
22. *Achnanthes Meyeri* sp. nov.
23. *Achnanthes Meyeri* sp. nov.
24. *Eucocconeis baikalensis* sp. nov.
25. *Achnanthes lanceolata* Breb.
26. *Achnanthes profunda* sp. nov.
27. *Achnanthes Lacus Baikali* sp. nov.
28. *Achnanthes lanceolata* Breb.
29. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
30. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
31. *Achnanthes profunda* sp. nov.
32. *Achnanthes hastata* Skv. and Meyer.
33. *Achnanthes hastata* Skv. and Meyer.
34. *Achnanthes baikalensis* Skv. and Meyer.
35. *Achnanthes baikalensis* Skv. and Meyer.
36. *Achnanthes Clevei* Grun. var. *rostrata* Hust.
37. *Achnanthes profunda* sp. nov.
38. *Cocconeis diminuta* Pant.
39. *Cocconeis diminuta* Pant.
40. *Achnanthes Oestrupii* (A. Cleve) Hust. var. *minuta* var. nov.
41. *Eucocconeis baikalensis* sp. nov.
42. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
43. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
44. *Eucocconeis baikalensis* sp. nov.

FIG. 45. *Achnanthes striata* Skv. and Meyer.
46. *Achnanthes striata* Skv. and Meyer.
47. *Achnanthes striata* Skv. and Meyer.
48. *Opephora Martyi* Herib. var. *baikalensis* var. nov.
49. *Fragilaria pinnata* Ehr.
50. *Eucocconeis baikalensis* sp. nov.
51. *Cocconeis placentula* (Ehr.) var. *lineata* (Ehr.) Cleve.
52. *Cocconeis placentula* (Ehr.) var. *Rouxii* Brun and Herib.
53. *Cocconeis placentula* (Ehr.) var. *Rouxii* Brun and Herib.
54. *Fragilaria spinosa* sp. nov.
55. *Fragilaria pinnata* Ehr. var. *baikalensis* var. nov.
56. *Opephora Martyi* Herib.
57. *Eucocconeis baikalensis* sp. nov.
58. *Eucocconeis baikalensis* sp. nov.
59. *Fragilaria spinosa* sp. nov.
60. *Gyrosigma acuminatum* (Kütz.) Rabh. var. *baikalensis* var. nov.
61. *Synedra rumpens* Kütz.
62. *Gyrosigma Spenserii* (W. Smith) Cleve var. *nodifera* Grun.
63. *Eucocconeis onegensis* Wisl. and Kolbe.
64. *Gyrosigma baikalensis* sp. nov.
65. *Gyrosigma baikalensis* sp. nov.
66. *Eucocconeis onegensis* Wisl. and Kolbe.

PLATE 6

FIG. 1. *Diploneis puella* (Schum.) Cleve.
2. *Diploneis baikalensis* Skv. and Meyer.
3. *Diploneis domblittensis* (Grun.) Cleve.
4. *Diploneis elliptica* Cleve var. *ladogensis* Cleve.
5. *Diploneis marginestriata* Hust. var. *nipponica* Skv.
6. *Diploneis lata* sp. nov. var. *punctata* var. nov.
7. *Diploneis domblittensis* (Grun.) Cleve var. *baikalensis* var. nov.
8. *Diploneis Boldtiana* Cleve var. *baikalensis* var. nov.
9. *Diploneis turgida* sp. nov.
10. *Diploneis turgida* sp. nov. var. *bipunctata* var. nov.
11. *Diploneis Meyeri* sp. nov.
12. *Diploneis lata* sp. nov. var. *minuta* var. nov.
13. *Diploneis ovalis* (Hilse) Cleve.
14. *Diploneis subovalis* Cleve var. *baikalensis* var. nov.
15. *Diploneis domblittensis* (Grun.) Cleve var. *baikalensis* var. nov.
16. *Diploneis ovalis* (Hilse) Cleve var. *nipponica* Skv.
17. *Diploneis lata* sp. nov.
18. *Diploneis baikalensis* Skv. and Meyer.
19. *Diploneis puella* (Schum.) Cleve var. *baikalensis* var. nov.

PLATE 7

FIG. 1. *Stauroneis baikalensis* sp. nov.
2. *Navicula subhamulata* Grun. var. *gibbosa* var. nov.
3. *Navicula cuspidata* Kütz.
4. *Navicula costulata* Grun. var. *baikalensis* var. nov.
5. *Navicula Werestschagini* Skv. and Meyer.

FIG. 6. *Navicula confervacea* Kütz. var. *baikalensis* var. nov.
7. *Neidium dubium* (Ehr.) Cleve var. *baikalensis* var. nov.
8. *Navicula peregrina* (Ehr.) Kütz.
9. *Navicula Lacus Baikali* Skv. and Meyer var. *lanceolata* var. nov.
10. *Caloneis silicula* (Ehr.) Cleve.
11. *Navicula hasta* Pant.
12. *Caloneis latiuscula* (Kütz.) Cleve.
13. *Navicula anglica* Ralfs.
14. *Caloneis relicta* sp. nov.
15. *Navicula delicatula* sp. nov.
16. *Navicula anglica* Ralfs?
17. *Stauroneis anceps* Ehr. var. *baikalensis* var. nov.
18. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baikalensis* fo. nov.
19. *Navicula hasta* Pant.
20. *Navicula lanceolata* (Agardh.) Kütz.
21. *Navicula lacustris* Greg. var. *baikalensis* var. nov.
22. *Navicula costuloides* sp. nov.
23. *Navicula Lacus Baikali* Skv. and Meyer.
24. *Navicula vulpina* Kütz. var. *oregonica* Cleve.
25. *Navicula cryptocephala* Kütz. var. *exilis* (Kütz.) Grun.
26. *Navicula subocculata* Hust. var. *baikalensis* var. nov.
27. *Navicula Meyeri* sp. nov.
28. *Navicula arguens* sp. nov.
29. *Caloneis delicatula* sp. nov.
30. *Navicula menisculus* Schum.
31. *Neidium Lacus Baikali* sp. nov.
32. *Navicula anglica* Ralfs.
33. *Neidium dilatatum* (Ehr.) Cleve fo. *curta* fo. nov.
34. *Navicula placentula* (Ehr.) Grun. fo. *jenisseyensis* (Grun.) Meister.
35. *Navicula dahurica* sp. nov.
36. *Navicula gastrum* Ehr.

PLATE 8

FIG. 1. *Navicula granulifera* sp. nov.
2. *Navicula exigua* (Greg.) O. Müll.
3. *Navicula tuscula* (Ehr.) Grun.
4. *Navicula paradoxa* sp. nov.
5. *Navicula lacustris* Greg.
6. *Navicula rhynchocephala* Kütz.
7. *Navicula dahurica* sp. nov.
8. *Cymbella amphicephala* Naeg. var. *unipunctata* Brun.
9. *Navicula peregrina* (Ehr.) Kütz. var. *kefringensis* (Ehr.) Cleve?
10. *Navicula unipunctata* sp. nov.
11. *Navicula torneensis* Cleve var. *aboensis* Cleve.
12. *Navicula delicatula* sp. nov.
13. *Navicula Lacus Baikali* Skv. and Meyer var. *lanceolata* var. nov.
14. *Caloneis silicula* (Ehr.) Cleve var. *major* var. nov.
15. *Neidium dilatatum* (Ehr.) Cleve.

FIG. 16. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *undulata* **fo. nov.**
17. *Navicula annulata* Grun. var. *baikalensis* var. nov.
18. *Caloneis Zachariasi* Reich. var. *elongata* var. nov.
19. *Navicula peregrina* (Ehr.) Kütz.
20. *Caloneis relicta* sp. nov.
21. *Navicula pupula* Kütz. var. *baikalensis* var. nov.
22. *Navicula pupula* Kütz. var. *capitata* Hust.
23. *Neidium dubium* (Ehr.) Cleve fo. *constricta* Hust.
24. *Navicula cingens* sp. nov.
25. *Navicula magna* sp. nov.
26. *Caloneis ignorata* sp. nov.
27. *Navicula magna* sp. nov.
28. *Navicula lanceolata* (Agardh) Kütz. var. *tenuirostris* var. nov.
29. *Caloneis Schumanniana* (Grun.) Cleve.
30. *Navicula placentula* (Ehr.) Grun. fo. *jenissejensis* (Grun.) Meister.
31. *Navicula rostellata* Kütz.
32. *Cymbella navicula* sp. nov.
33. *Caloneis Schummanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baikalensis* fo. nov.
34. *Caloneis simplex* sp. nov.
35. *Cymbella navicula* sp. nov.
36. *Navicula acuta* sp. nov.
37. *Navicula bacillum* Ehr.

PLATE 9

FIG. 1. *Navicula Wislouchii* Skv. and Meyer.
2. *Navicula placentula* (Ehr.) Grun.
3. *Navicula Lacus Baikali* Skv. and Meyer.
4. *Navicula amphibola* Cleve var. *curta* var. nov.
5. *Navicula fluens* Hust. var. *subrostrata* var. nov.
6. *Navicula vulpina* Kütz.
7. *Navicula cryptocephala* Kütz.
8. *Navicula Lacus Baikali* Skv. and Meyer var. *simplex* Skv. and Meyer.
9. *Navicula cryptocephala* Kütz. var. *veneta* (Kütz.) Grun.
10. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baikalensis* fo. nov.
11. *Navicula costulata* Grun.
12. *Navicula rhynchocephala* Kütz. var. *tenua* Skv.
13. *Navicula subocculata* Hust. var. *unilateralis* var. nov.
14. *Navicula gracilis* Ehr.
15. *Navicula cryptocephala* Kütz.
16. *Navicula bacillum* Ehr.
17. *Navicula atomus* (Naeg.) Grun.
18. *Navicula torneensis* Cleve var. *aboensis* Cleve.
19. *Navicula delicatula* sp. nov.

FIG. 20. *Navicula pseudogracilis* sp. nov.
21. *Navicula pseudogracilis* sp. nov.
22. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun.
23. *Navicula rostellata* Kütz.
24. *Caloneis latiuscula* (Kütz.) Cleve.
25. *Navicula crucicula* (W. Smith) Donk. var. *obtusata* Grun.
26. *Pinnularia leptosoma* Grun.
27. *Caloneis Zachariasi* Reich. var. *constricta* var. nov.
28. *Navicula magna* sp. nov. var. *lanceolata* var. nov.
29. *Navicula Meyeri* sp. nov.
30. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
31. *Navicula subplacentula* Hust. var. *baikalensis* var. nov.
32. *Caloneis Zachariasi* Reich.?
33. *Caloneis Zachariasi* Reich.?
34. *Navicula fluens* Hust. var. *baikalensis* var. nov.
35. *Caloneis latiuscula* (Kütz.) Cleve var. *rostrata* var. nov.
36. *Navicula magna* sp. nov.
37. *Navicula subhamulata* Grun. var. *parallela* Skv.
38. *Navicula lanceolata* (Ag.) Kütz. var. *cymbula* (Donk.) Cleve.
39. *Navicula silicea* sp. nov.
40. *Navicula scutelloides* W. Smith var. *baikalensis* var. nov.
41. *Neidium dubium* (Ehr.) Cleve.
42. *Navicula Meyeri* sp. nov.
43. *Navicula torneensis* Cleve var. *aboensis* Cleve.
44. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
45. *Caloneis Zachariasi* Reach. var. *constricta* var. nov.
46. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
47. *Navicula anglica* Ralfs var. *subsalsa* Grun.
48. *Navicula rhynchocephala* Kütz. var. *tenua* Skv.
49. *Stauroneis phœnicenteron* Ehr.

PLATE 10

FIG. 1. *Navicula americana* Ehr.
2. *Navicula Werestschagini* Skv. and Meyer.
3. *Neidium lanceolata* sp. nov.
4. *Neidium iridis* (Ehr.) Cleve var. *baikalensis* var. nov.
5. *Neidium antiqua* sp. nov.
6. *Navicula lacustris* Greg.
7. *Navicula Lacus Baikali* Skv. and Meyer var. *simplex* Skv. and Meyer.
8. *Frustulia rhomboides* (Ehr.) de Toni var. *amphipleuroides* Grun.
9. *Epithemia zebra* (Ehr.) Kütz.
10. *Diploneis Meyeri* sp. nov.
11. *Nitzschia dissipata* (Kütz.) Grun.
12. *Gomphonema firma* sp. nov.
13. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
14. *Navicula magna* sp. nov. var. *curta* var. nov.
15. *Epithemia turgida* (Ehr.) Kütz. var. *granulata* (Ehr.) Grun.

PLATE 11

FIG. 1. *Pinnularia abnormis* sp. nov.
2. *Pinnularia Lacus Baikali* sp. nov.
3. *Pinnularia Lacus Baikali* sp. nov.
4. *Nitzschia capitellata* Hust.
5. *Pinnularia major* (Kütz.) Cleve.
6. *Pinnularia Lacus Baikali* sp. nov. var. *linearis* var. nov.
7. *Rhopalodia gibba* (Ehr.) O. Müll.
8. *Epithemia intermedia* Fricke.
9. *Pinnularia molaris* Grun.
10. *Pinnularia pectinalis* sp. nov.
11. *Pinnularia pectinalis* sp. nov. var. *rostrata* var. nov.
12. *Pinnularia pectinalis* sp. nov. var. *rostrata* var. nov.
13. *Nitzschia angustata* (W. Smith) Grun.
14. *Rhopalodia gibba* (Ehr.) O. Müll. var. *mongolica* Oestr.
15. *Pinnularia viridissima* sp. nov.
16. *Pinnularia major* (Kütz.) Cleve fo. *minor* fo. nov.
17. *Pinnularia gibba* Ehr. var. *baikalensis* var. nov.
18. *Pinnularia Lacus Baikali* sp. nov. var. *gibbosa* var. nov.
19. *Nitzschia angustata* (W. Smith) Grun.
20. *Pinnularia Lacus Baikali* sp. nov. var. *lanceolata* var. nov.
21. *Pinnularia Lacus Baikali* sp. nov.
22. *Pinnularia crassa* sp. nov.

PLATE 12

FIG. 1. *Amphora costulata* sp. nov.
2. *Amphora ovalis* Kütz. var. *pediculus* Kütz.
3. *Cymbella parva* (W. Smith) Cleve.
4. *Amphora delphinea* (Bail.) A. Smith.
5. *Amphora Normani* Rabh.
6. *Amphora mongolica* Oestr. var. *cornuta* var. nov.
7. *Amphora mongolica* Oestr. var. *cornuta* var. nov. fo. *interrupta* fo. nov.
8. *Amphora mongolica* Oestr. var. *baikalensis* Skv. and Meyer.
9. *Cymbella turgida* (Greg.) Cleve.
10. *Amphora ovalis* Kütz. fo. *gracilis* (Ehr.) Cleve.
11. *Cymbella ventricosa* Kütz.
12. *Amphora sibirica* Skv. and Meyer.
13. *Amphora mongolica* Oestr. var. *gracilis* var. nov.
14. *Amphora sibirica* Skv. and Meyer.
15. *Cymbella Hustedtii* Krasske?
16. *Amphora Proteus* Greg. var. *baikalensis* var. nov.
17. *Amphora ovalis* Kütz. var. *constricta* var. nov.
18. *Amphora rotunda* sp. nov.
19. *Amphora sibirica* Skv. and Meyer var. *gracilis* var. nov.
20. *Amphora obtusa* Greg. var. *baikalensis* var. nov.
21. *Amphora mongolica* Oestr.
22. *Amphora perpusilla* Grun.
23. *Amphora sibirica* Skv. and Meyer.
24. *Amphora ovalis* Kütz.

FIG. 25. *Amphora Proteus* Greg. var. *baikalensis* var. nov.
26. *Amphora sibirica* Skv. and Meyer.
27. *Amphora sibirica* Skv. and Meyer.
28. *Amphora obtusa* Greg. var. *baikalensis* var. nov.

PLATE 13

FIG. 1. *Cymbella cuspidata* Kütz.
2. *Cymbella Stuxbergii* Cleve var. *intermedia* Wisl.
3. *Cymbella Stuxbergii* Cleve var. *intermedia* Wisl.
4. *Cymbella australica* A. Schmidt fo. elongata Skv. and Meyer.
5. *Cymbella Stuxbergii* Cleve var. *baikalensis* var. nov.
6. *Cymbella Meisteri* Skv. and Meyer.
7. *Cymbella Gutwinskii* (Wisl.) Skv. and Meyer.
8. *Cymbella Meisteri* Skv. and Meyer.
9. *Cymbella Stuxbergii* Cleve.
10. *Cymbella inelegans* Cleve var. *baikalensis* var. nov.
11. *Cymbella ventricosa* Kütz.
12. *Cymbella heteropleura* Ehr. var. *minor* Cleve.
13. *Cymbella navicula* sp. nov.
14. *Cymbella sinuata* Greg.
15. *Cymbella heteropleura* Ehr. var. *minor* Cleve.
16. *Cymbella Hustedtii* Krasske?
17. *Cymbella australica* A. Schmidt fo. *elongata* Skv. and Meyer.
18. *Cymbella ventricosa* Kütz.
19. *Cymbella Stuxbergii* Cleve var. *baikalensis* var. nov.
20. *Cymbella Meisteri* Skv. and Meyer.
21. *Cymbella Ehrenbergii* Kütz.
22. *Cymbella Gutwinskii* (Wisl.) Skv. and Meyer.
23. *Cymbella prostrata* (Berk.) Cleve.
24. *Cymbella cistula* (Hem.) Grun.
25. *Cymbella Ehrenbergii* Kütz.
26. *Cymbella Meisteri* Skv. and Meyer.
27. *Cymbella cuspidata* Kütz.?
28. *Cymbella turgida* (Greg.) Cleve.
29. *Cymbella capricornis* sp. nov.
30. *Fragilaria Lacus Baikali* sp. nov.
31. *Cymbella cistula* (Hem.) Grun.

PLATE 14

FIG. 1. *Gomphonema innata* sp. nov. var. *elegans* var. nov.
2. *Gomphonema innata* sp. nov.
3. *Gomphonema intricatum* Kütz. var. *minor* var. nov.
4. *Gomphonema delicatula* sp. nov.
5. *Gomphonema ventricosum* Greg.
6. *Gomphonema intricatum* Kütz. var. *pumila* Grun.
7. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
8. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *curvata* fo. nov.
9. *Cymbella lacustris* Ag. fo. *baikalensis* Skv. and Meyer.

FIG. 10. *Rhoicosphenia curvata* (Kütz.) Grun.
11. *Gomphonema ventricosum* Greg.
12. *Gomphonema lanceolatum* Ehr.
13. *Gomphonema quadripunctatum* (Oestr.) Wisl.
14. *Gomphonema intricatum* Kütz. var. *minor* var. nov.
15. *Didymosphenia dentata* Dorog. var. *subcapitata* Skv. and Meyer.
16. *Gomphonema quadripunctatum* (Oestr.) Wisl.
17. *Gomphonema quadripunctatum* (Oestr.) Wisl. var. *hastata* Wisl.?
18. *Gomphonema quadripunctatum* (Oestr.) Wisl.
19. *Gomphonema delicatula* sp. nov. var. *bipunctata* var. nov.
20. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *curvata* fo. nov.
21. *Gomphonema olivaceum* (Lyngb.) Kütz.
22. *Gomphonema ventricosum* Greg.
23. *Didymosphenia dentata* Dorog.
24. *Gomphonema ventricosum* Greg.
25. *Gomphonema lanceolatum* Ehr.
26. *Gomphonema lanceolatum* Ehr. var. *capitata* var. nov.

PLATE 15

FIG. 1. *Surirella oöphora* sp. nov.
2. *Surirella Lacus Baikali* sp. nov.
3. *Surirella Nyassæ* O. Müll. var. *baikalensis* var. nov.
4. *Cymatipleura solea* (Breb.) W. Smith.
5. *Cymatopleura solea* (Breb.) W. Smith.
6. *Surirella paucidens* sp. nov.
7. *Surirella biseriata* Breb. var. *bifrons* (Ehr.) Hust. fo. *punctata* Meister.
8. *Surirella Lacus Baikali* sp. nov. var. *marginata* var. nov.
9. *Surirella Lacus Baikali* sp. nov. var. *paradoxa* var. nov.

PLATE 16

FIG. 1. *Surirella conifera* sp. nov.
2. *Cymatopleura solea* (Breb.) W. Smith.
3. *Surirella uninodes* sp. nov.
4. *Surirella conifera* sp. nov. var. *punctata* var. nov.
5. *Surirella margaritifera* Hust.
6. *Surirella Nyassæ* O. Müll. var. *baikalensis* var. nov.
7. *Campylodiscus rutilus* sp. nov.
8. *Surirella didyma* Kütz. var. *minor* var. nov.
9. *Surirella Lacus Baikali* sp. nov. var. *marginata* var. nov.
10. *Surirella turgida* W. Smith fo. *baikalensis* fo. nov.
11. *Surirella Lacus Baikali* sp. nov. var. *punctata* var. nov.
12. *Surirella granulata* Oestr.
13. *Surirella linearis* W. Smith var. *helvetica* (Brun) Meister?

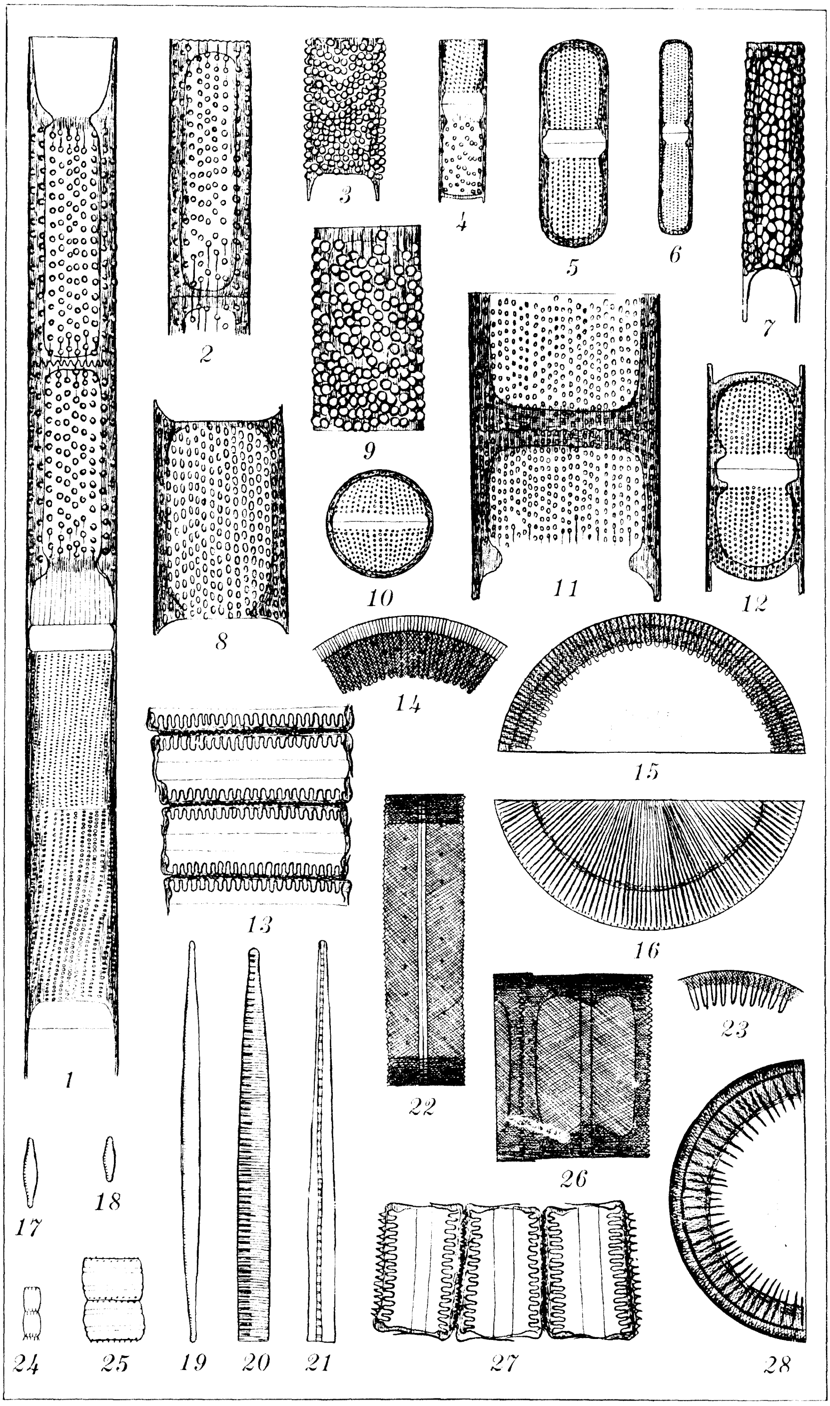
PLATE 17

FIG. 1. *Surirella biseriata* Breb. var. *bifrons* (Ehr.) Hust. fo. *punctata* Meister.
2. *Surirella margaritifera* Hust.
3. *Surirella unidentata* sp. nov.

FIG. 4. *Surirella acuminata* Hust. var. *baikalensis* var. nov.
5. *Surirella gracilis* (W. Smith) Grun.
6. *Campylodiscus rutilus* sp. nov.
7. *Surirella prehensilis* sp. nov.
8. *Surirella paucidens* sp. nov. var. *punctata* var. nov.
9. *Campylodiscus Lacus Baikali* sp. nov.
10. *Campylodiscus Lacus Baikali* sp. nov. var. *annulata* var. nov.
11. *Surirella linearis* W. Smith.
12. *Cymatopleura solea* (Breb.) W. Smith var. *apiculata* (W. Smith) Grun.
13. *Cymatopleura solea* (Breb.) W. Smith.
14. *Surirella paucidens* sp. nov. var. *punctata* var. nov.

PLATE 18

FIG. 1. *Campylodiscus fragilis* sp. nov. var. *punctata* var. nov.
2. *Campylodiscus fragilis* sp. nov.
3. *Neidium Lacus Baikali* sp. nov., middle part of the valve.
4. *Campylodiscus fragilis* sp. nov.
5. *Campylodiscus fragilis* sp. nov.
6. *Cymatopleura angulata* Grev.
7. *Campylodiscus fragilis* sp. nov.
8. *Campylodiscus Lacus Baikali* sp. nov. var. *hispidula* var. nov.
9. *Campylodiscus fragilis* sp. nov.
10. *Cymatopleura elliptica* (Breb.) W. Smith var. *constricta* Grun.
11. *Campylodiscus fragilis* sp. nov. var. *rigens* var. nov.
12. *Campylodiscus fragilis* sp. nov. var. *rigens* var. nov.



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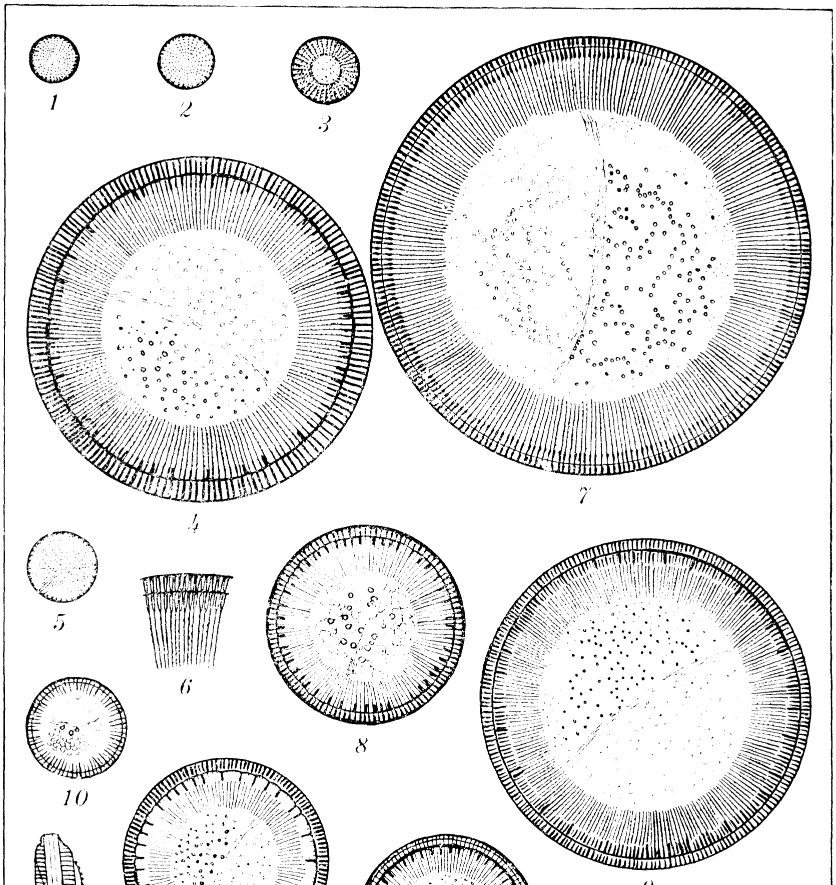

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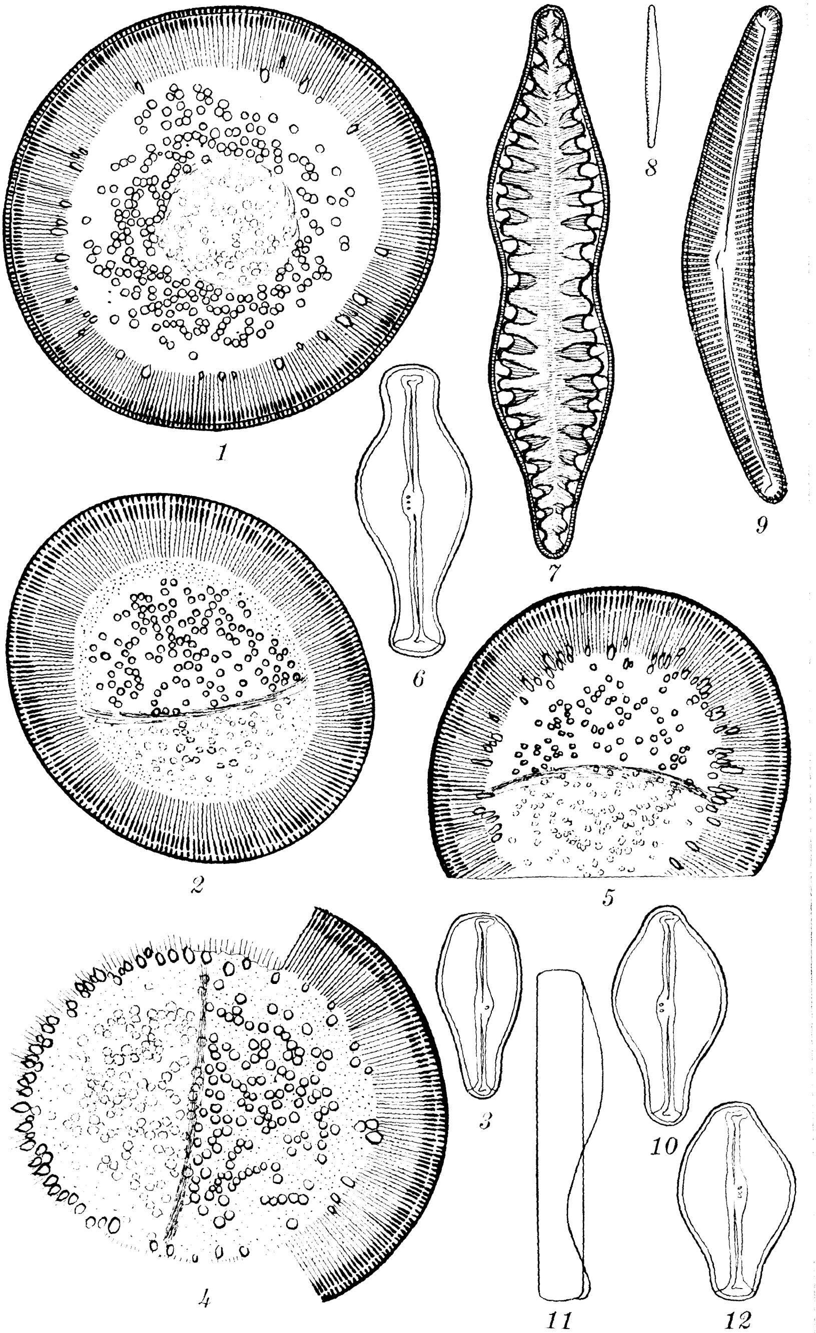

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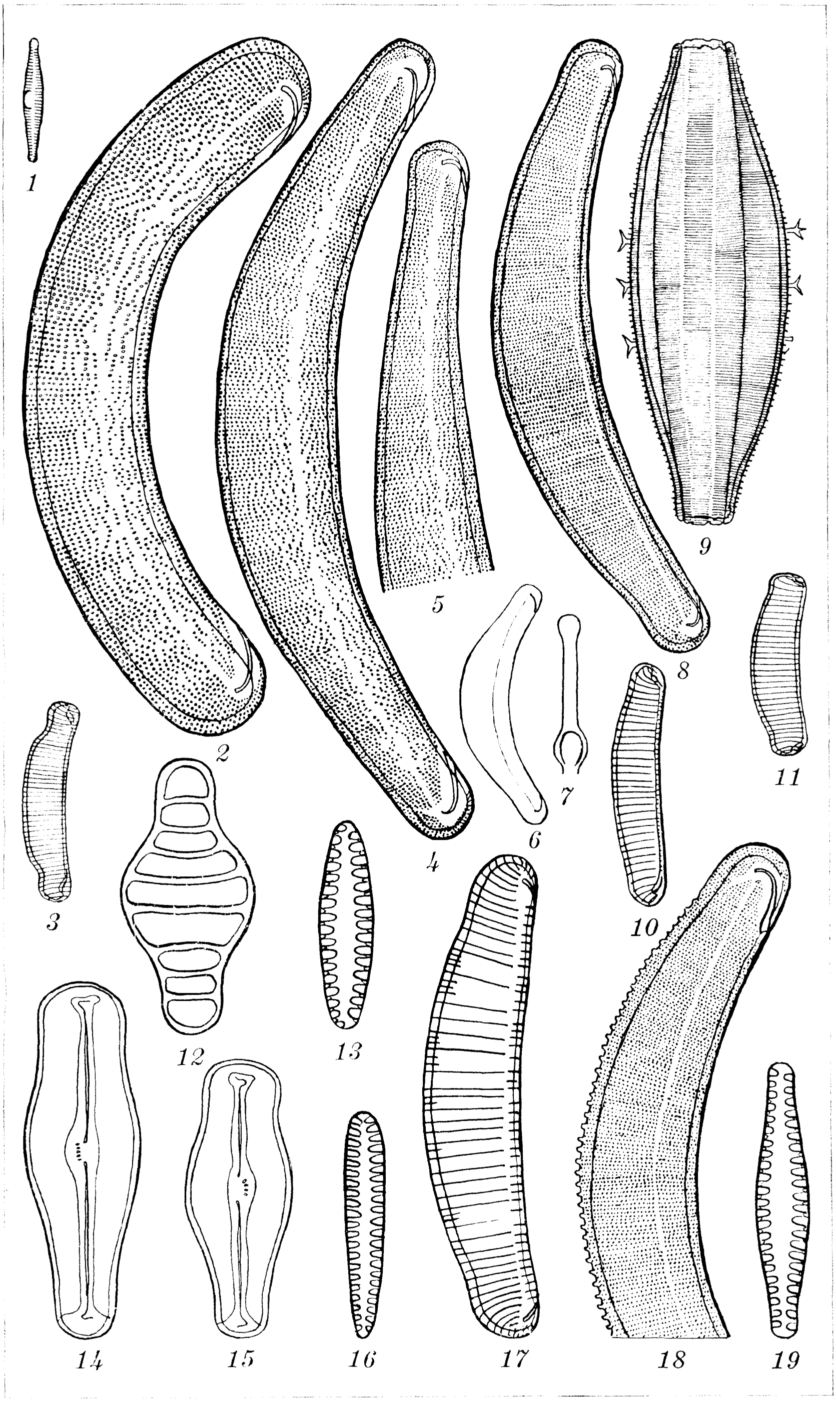

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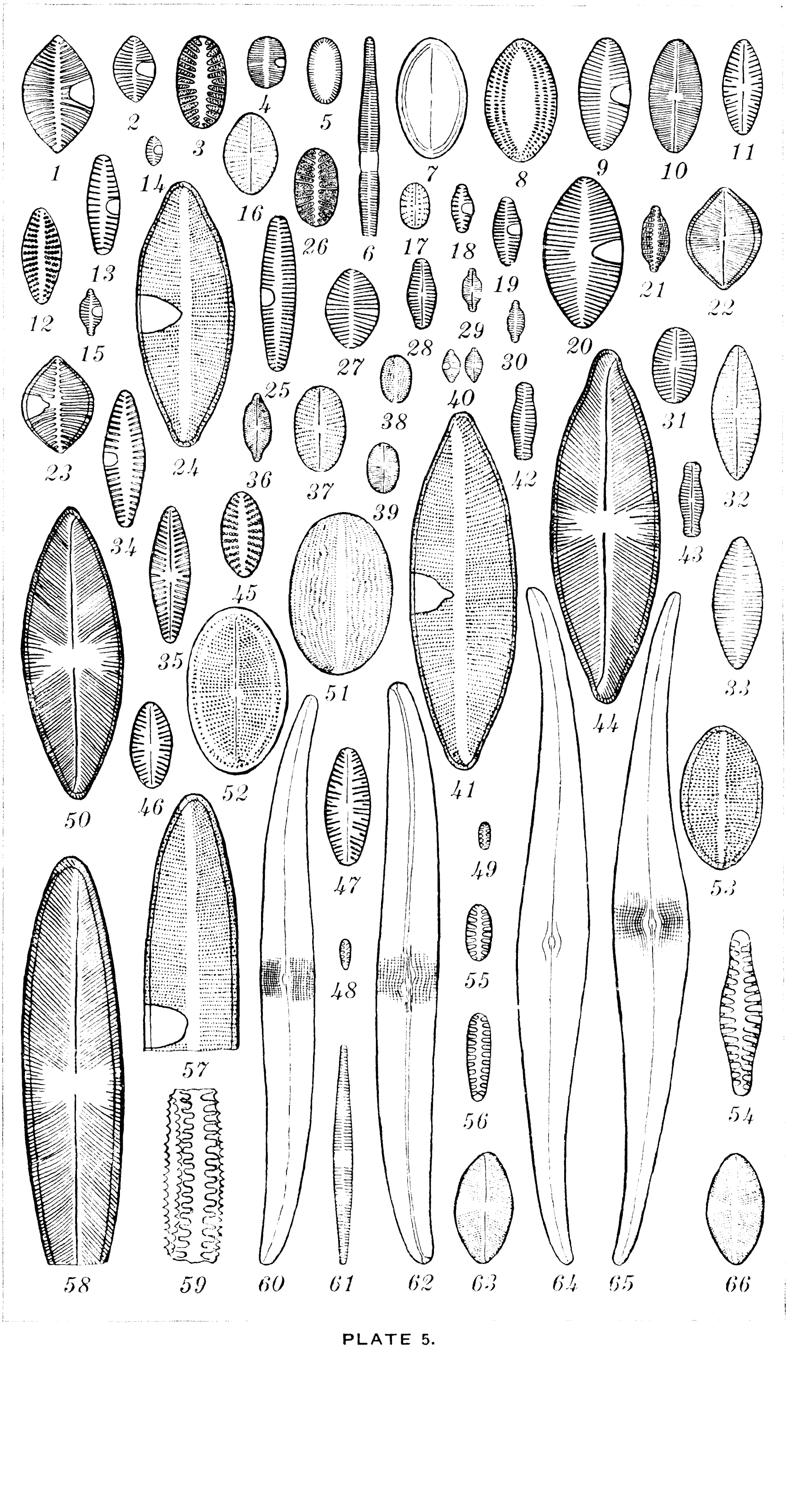
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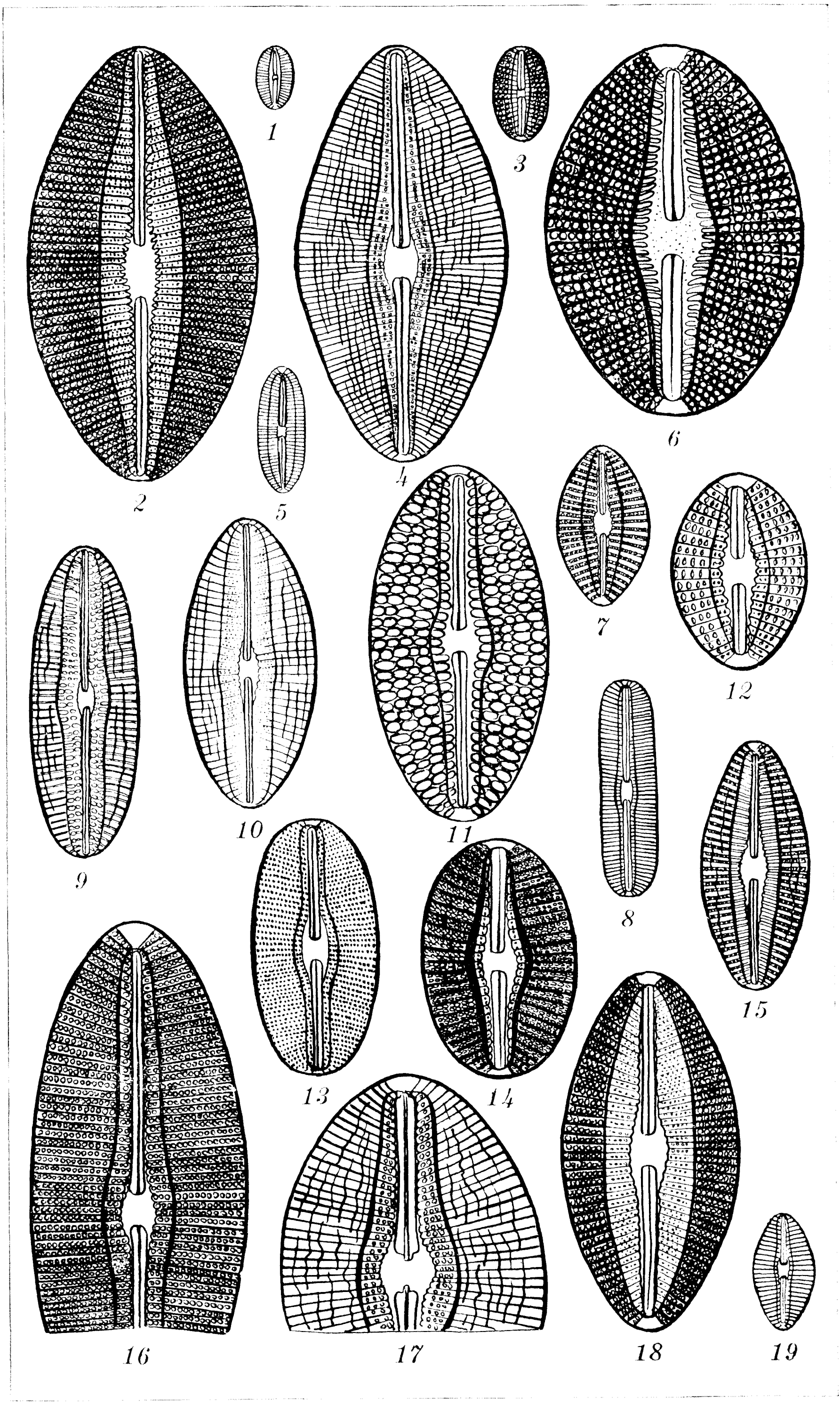
PLATE 5.



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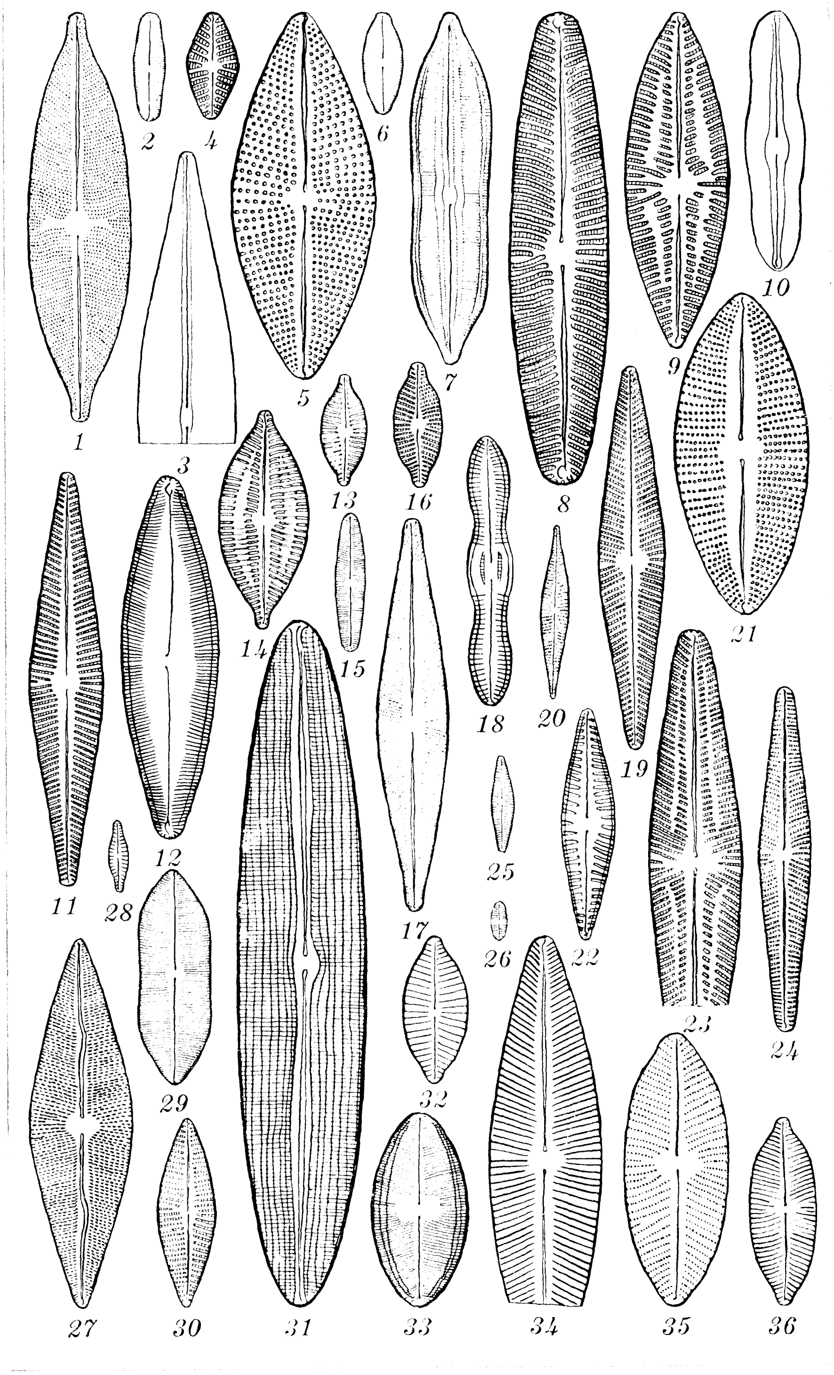
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PLATE 7.

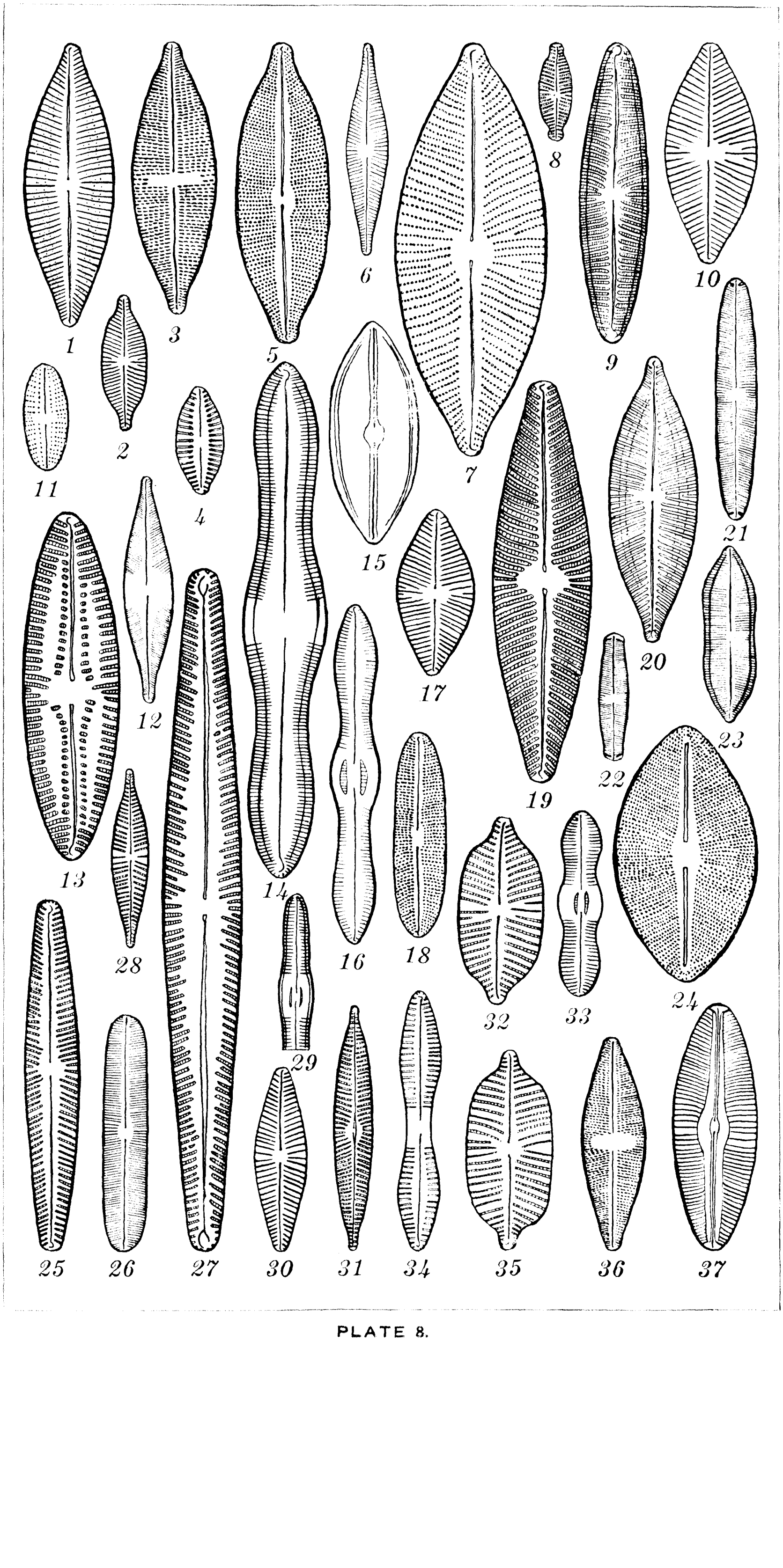
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PLATE 8.

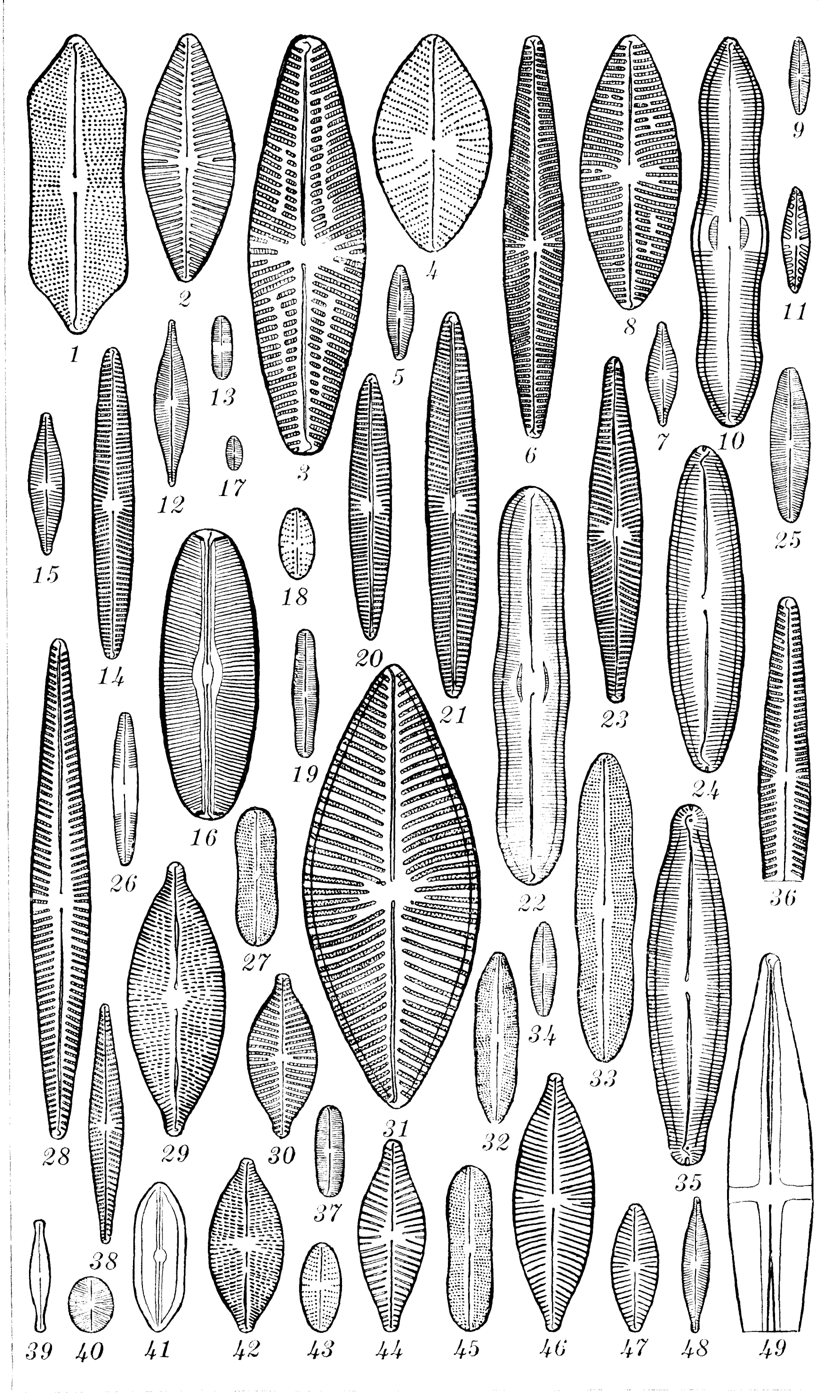
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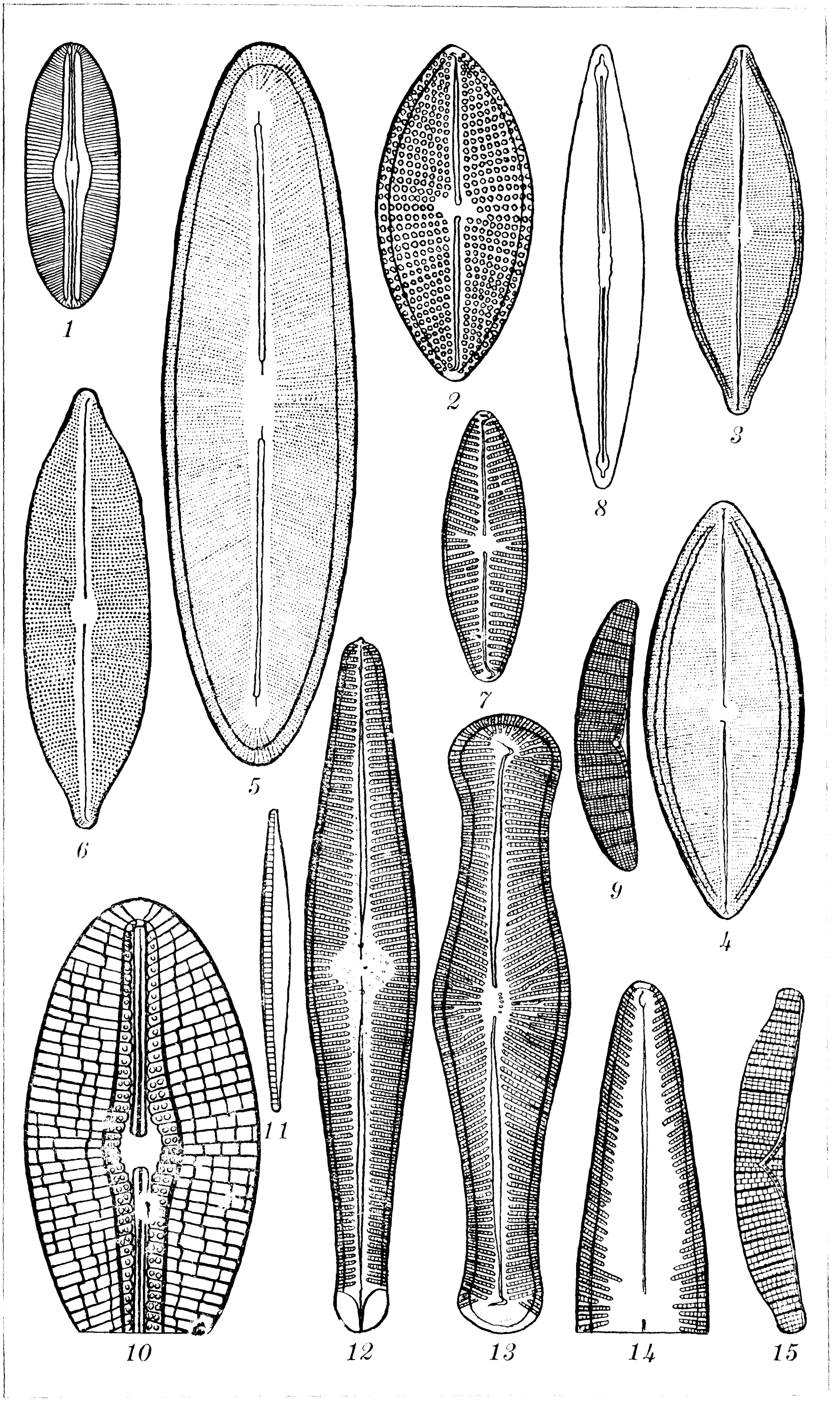
PLATE 9.



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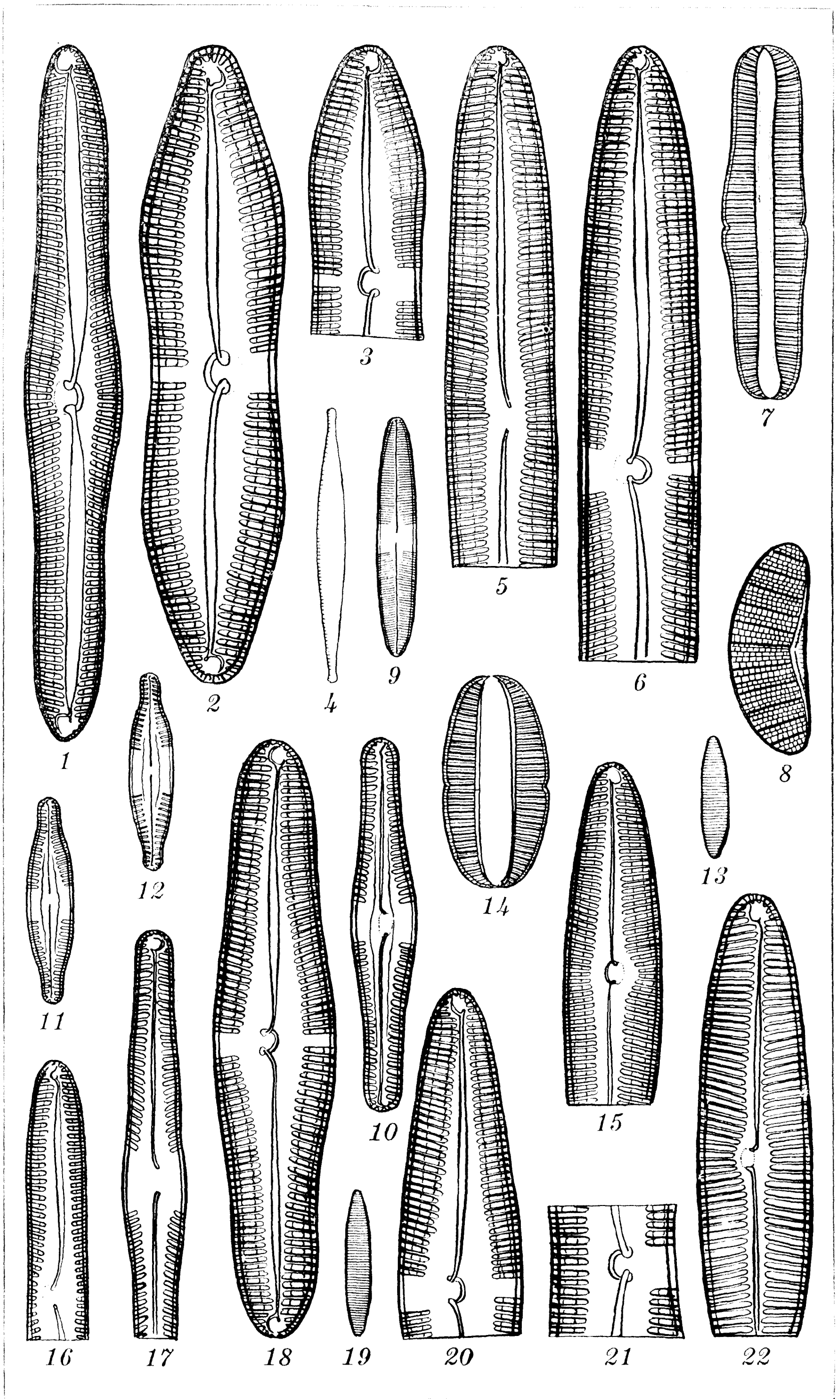

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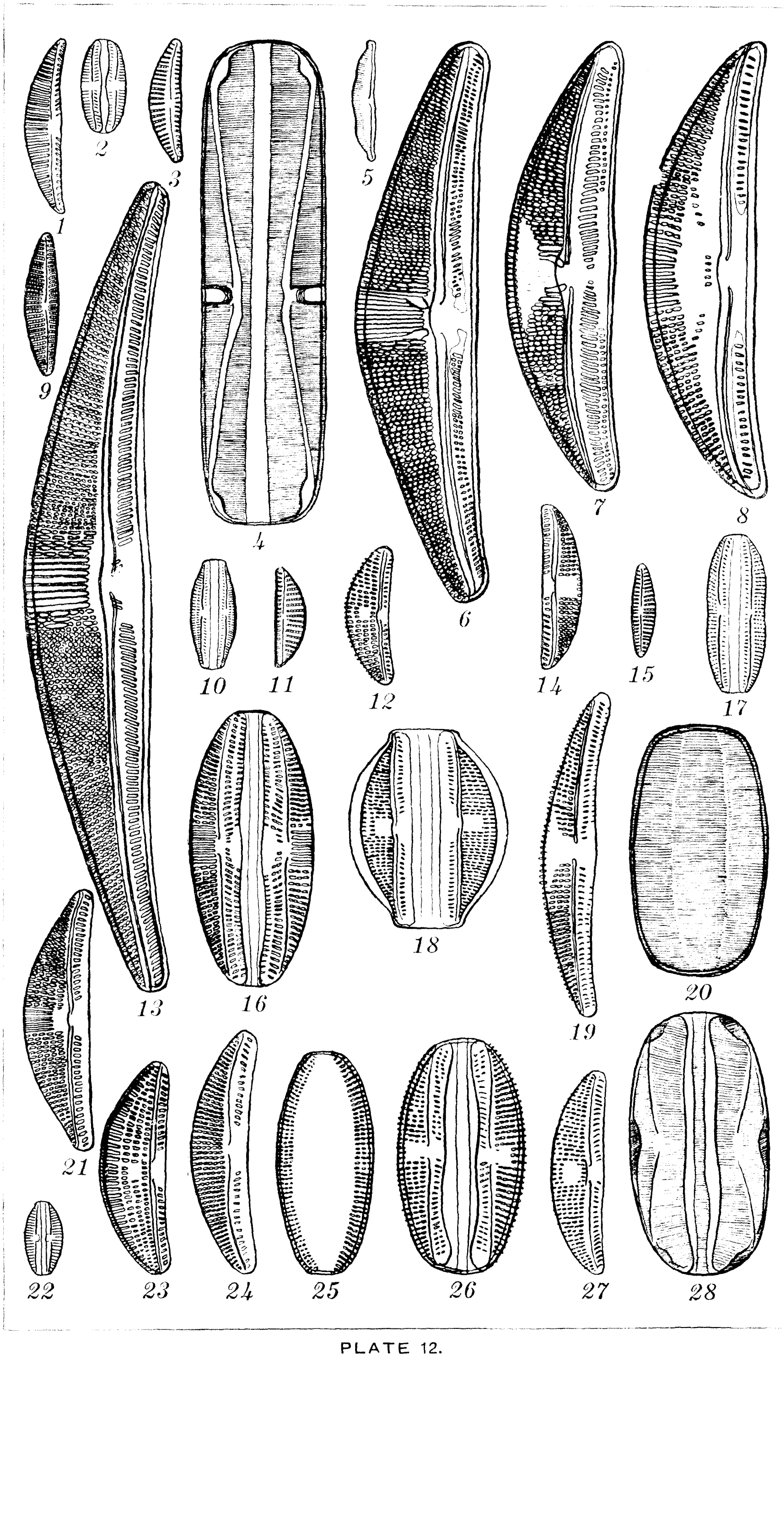

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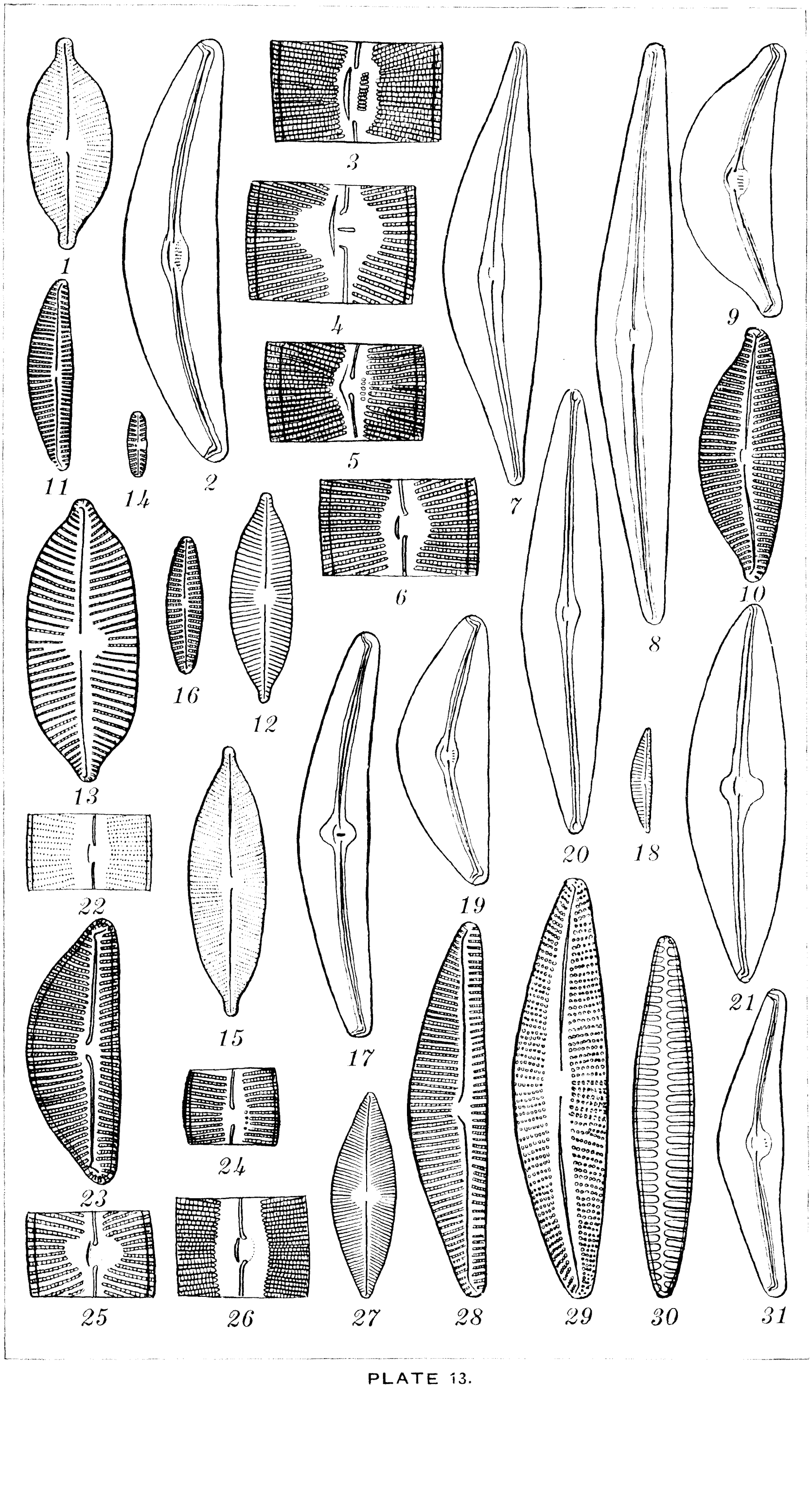
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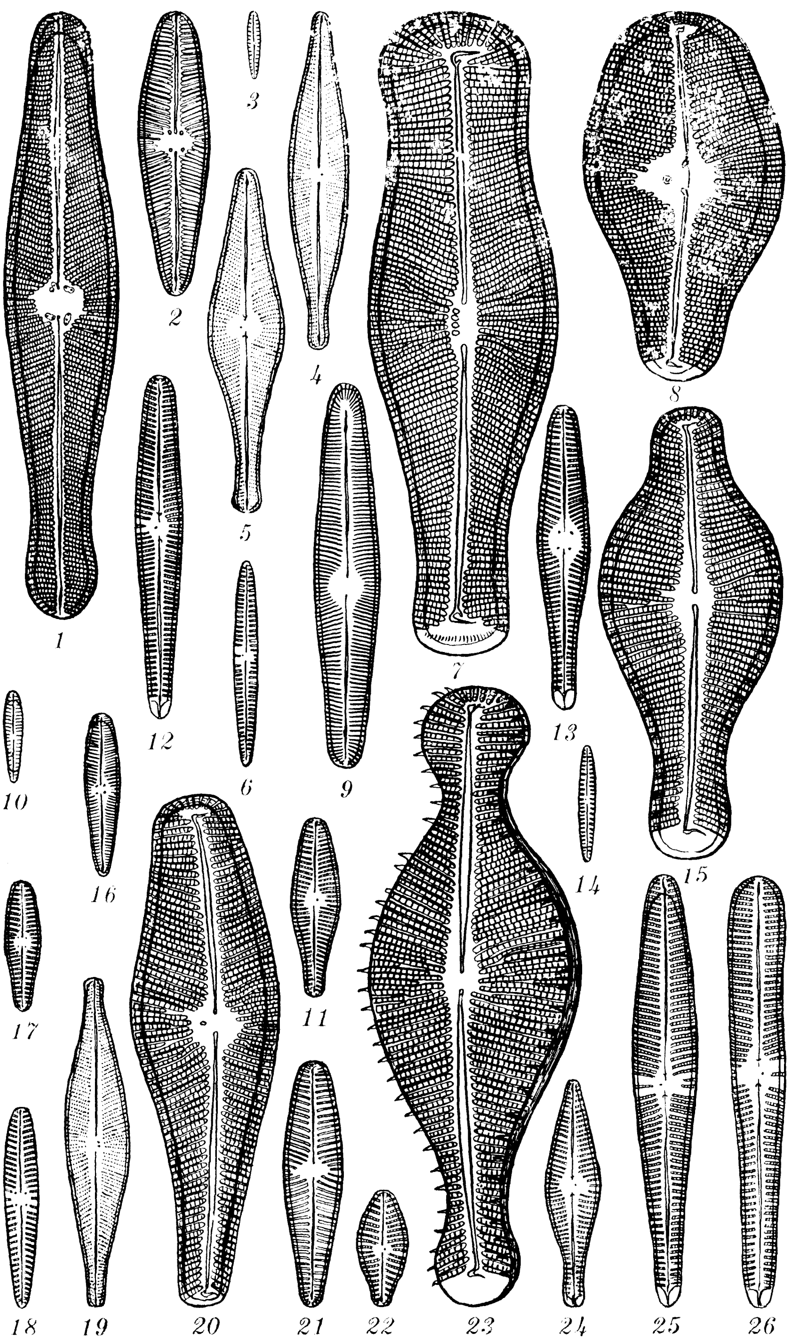
PLATE 13.



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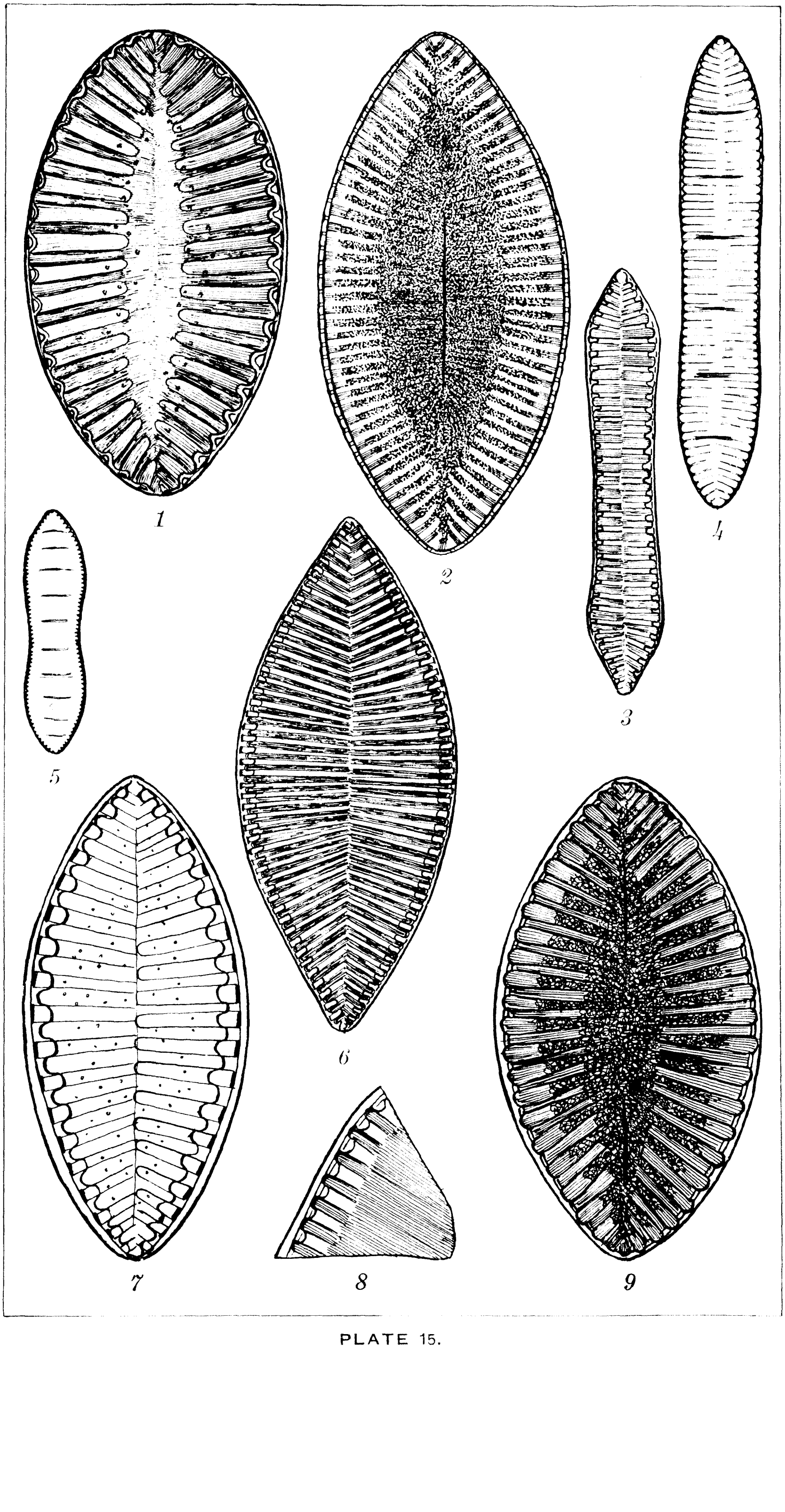

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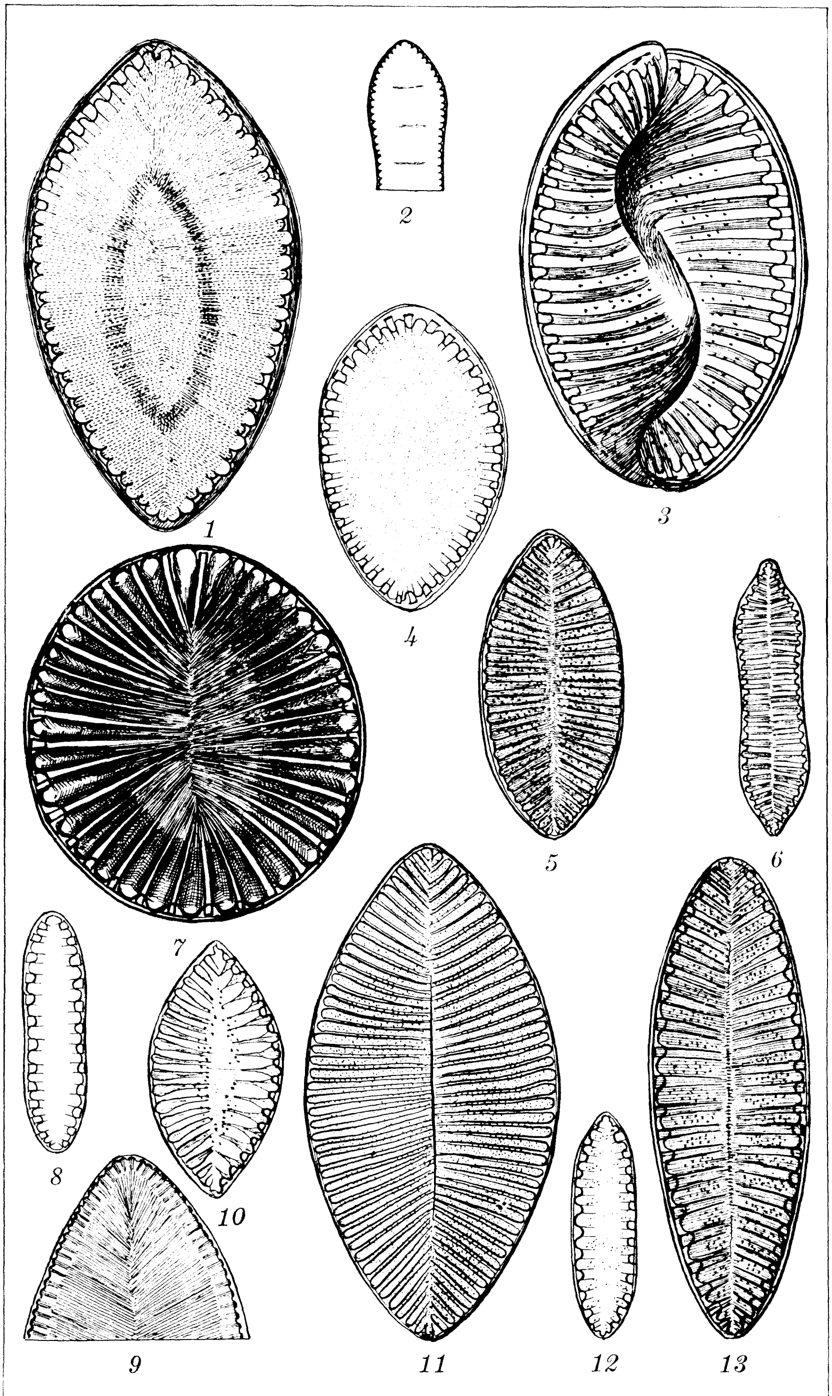

PLATE 16.

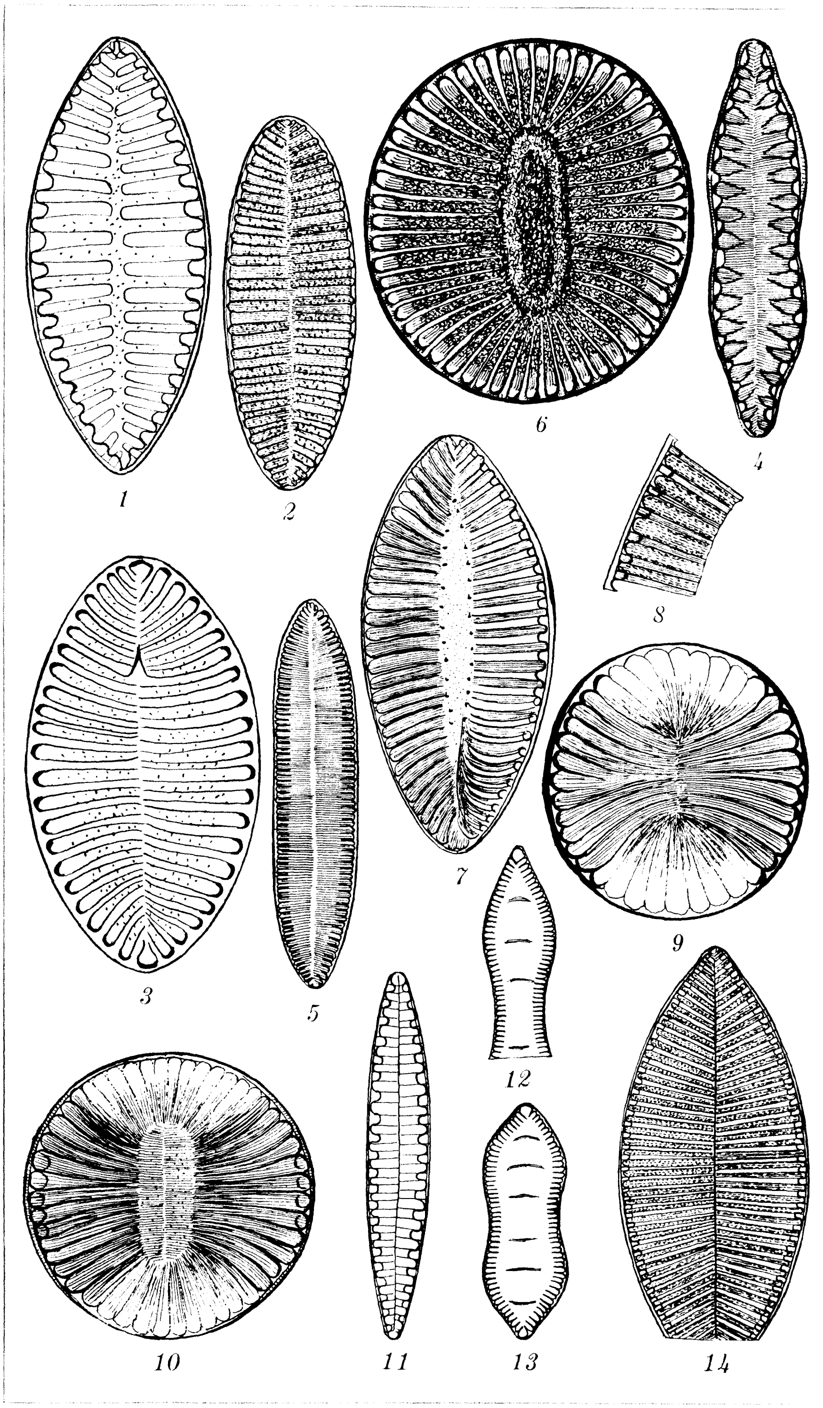

PLATE 17.

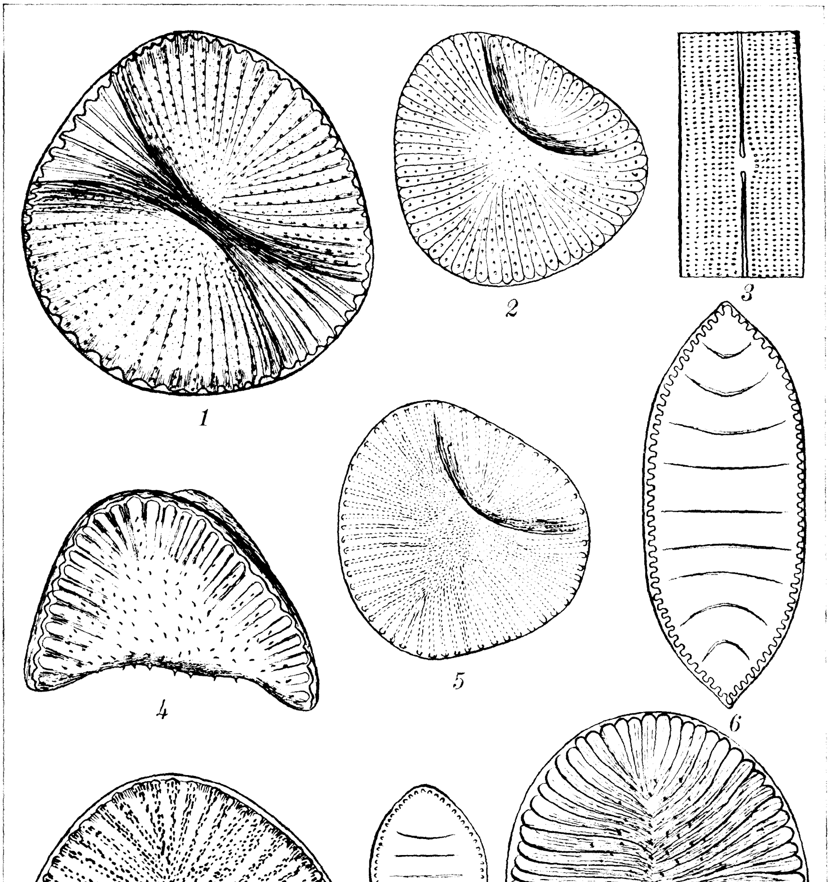

PLATE 18.

BENEFICIAL SWIFTLET AND EDIBLE BIRDS' NEST INDUSTRY IN BACUIT, PALAWAN

By CANUTO G. MANUEL

Of the Fish and Game Administration, Bureau of Science, Manila

THREE PLATES

Edible bird's nests consist of a gelatinous substance produced by certain birds known as swiftlets. These nests are built in limestone caves along the seashore in many parts of the Philippines. Their value as a delicacy and food for convalescents is well known to the Chinese. Since the early days of Sino-Filipino trade relations, local Chinese merchants have been exporting this product to China, and since then the business has remained entirely in their hands. In the Philippines the famous edible-nest soup can be obtained only in high-class Chinese restaurants. Although, according to Stresemann,(11) the Philippines is one of the countries known to export edible nests, very few Filipinos are aware of the existence of this article of commerce in their country, and there is no official record available on the bulk of this trade. According to Dammerman,(2) the Netherlands Indies in 1927 exported 109,310 kilograms of edible nests worth 822,913 guilders.[1]

Among the places in the Philippines known for edible bird's nests are Bacuit, Coron, and Taytay, in Palawan Province, and Cagayan Sulu in the Sulu Sea. Of these localities only Bacuit derives a revenue from this industry as provided for in Act No. 3379 (see p. 384). This study was undertaken to determine the extent of the industry and the species of birds that build the edible nests in Bacuit. The actual field work was done with the assistance of Francisco S. Rivera, in Bacuit, Palawan, from April 13 to 29, 1936. Additional information was obtained from edible-nest stores in Manila.

The literature on edible nests is very limited. The writer is not aware of any article published in this country on edible bird's nests, or on the birds building them, that is of any scien-

[1] One guilder is equivalent to approximately 60 cents United States currency.

tific significance, except for the results of chemical analysis(6) for food value. Two investigators, however, Dr. Alfred Worm, formerly of the Bureau of Science, and Mr. Antonio V. Perez, of the Bureau of Forestry, were sent to Bacuit to study the condition of the industry, and their reports were used freely in this paper. The writer is, therefore, under obligation to these gentlemen.

IDENTITY OF THE BIRDS

Several notions have been held concerning the birds that build edible nests. Some people believed them to be swallows.(1) It is now generally conceded, however, that edible nests are built by a swiftlet, belonging to the genus *Collocalia*, a bird far removed from the swallows. The specific identity, however, has baffled ornithologists. According to Sowerby(10) *Collocalia fuciphaga* (Thunb.), "the true edible swift," builds white nests. In the Philippines McGregor(8) cites Bourns and Worcester for the statement that *Collocalia troglodytes* Gray builds edible nests. The same statement appears in Hachisuka's description of that species.(4) Recently Stresemann(11) contends that the races *germani, inexpectata, vestita, javensis, micans,* and some other neighboring forms of the species *francica,* appear more and more to be the producers of edible nests. The bird we caught on a white nest in a cave in Bacuit has the following description: upper surface somewhat with greenish metallic or olivaceous gloss on head, neck, back, and upper tail coverts; wings, dusky neutral gray;[2] a band across rump as in under surface, smoky gray with dark brown shafts; tarsi unfeathered. It has the following measurements: wing, 120 mm; longest rectrix, 51 mm; shortest rectrix, 44. The bird is known to the natives as *balinsasayaw*.

This bird is identical with the swiftlets in the collection of the Bureau of Science, obtained from Cagayancillo and Cagayan Sulu islands, except for the color of the upper surface, which, in those from the latter islands, shows sign of fading. These birds were collected in 1901 and 1903. Incidentally, edible nests are known to occur in the last-named island. The meas-

[2] From Ridgway, R. Color Standard and Color Nomenclature. Washington, D. C. 1912.

urements of birds from Cagayan Sulu and Cagayancillo islands are as follows:

Locality.	Sex.	Wing.	Longest rectrix.	Shortest rectrix.
Cagayan Sulu	♂	119	51	47
Do	♂	119	49	42
Cagayancillo	♀	121	52	48
Do	♀	120	50	44
Do	♀	122	49	46
Do	♂	120	49	44
Do	♂	122	53	45
Do	♀	121	49	45

These measurements conform with those of Oberholser's(9) and Stresemann's(11) *Collocalia francica germani* Oustalet.

While Oberholser(9) mentions the Philippines in connection with the geographical distribution of the race *C. f. germani,* McGregor(8) was more specific, mentioning Cagayancillo, Cagayan Sulu, Calamianes, Cebu, Negros, and Panay. Stresemann(11) only mentions the Mergui Archipelago, the coasts of Tenasserim, Peninsular Siam, and the Malay States to the south nearly as far as Johore as localities of this species, although he indicates Luzon and Palawan as localities for *C. f. vestita,* an allied race of *C. f. germani.* Inspite of these diverse views concerning its distribution, this edible nest builder of Bacuit, Palawan, is allocated to *Collocalia francica germani* Oustalet.

HAUNTS AND HABITS OF THE SWIFTLET

The Municipality of Bacuit is situated on the west, near the northern limit of the island of Palawan. It has several smaller islands under its jurisdiction that are lying close to the mainland of Palawan. All these islands are characterized by limestone rocks, the remnants of a vast coral formation of prehistoric times. In these rocks are caves, some of them opening in very steep cliffs. Edible nests have been gathered at the following islands: Cadlao, Cauayan, Dilumacad, Inambuyod, Tapiutan, Lagen, Malpacao, Matinloc, Miniloc, and Inabuyatan. The exact number of caves in these islands, has, so far, not been determined; people of Bacuit interested in bird's nests estimated more than a thousand in the whole municipality. The size, depth, and direction of the caves vary, ranging from small ones

inhabited by about 20 pairs to large ones the number of inhabitants of which has not been determined. A *boceador* (nest collector) informed the writer that the rocks in the mainland of Bacuit proper are provided with a system of tunnels by which an experienced gatherer can enter any of the cave openings and go out by another way.

The walls of the caves are characterized by convexities, concavities, and protuberances. Their surfaces, however, are smooth, due perhaps to the action of water that has flown over them in the past. Generally the nests are attached to the upper end of a concavity, where they are safe from the birds that go in and out of the caves. The source of the nest materials has been much discussed, and the theories suggested by Green,(3) namely, algæ, fish spawn, and secretions of the swiftlets themselves, have narrowed down to the third. It is now generally admitted, on the basis of studies by Green,(3) Heiduschka and Graefe,(5) Krukenberg,(7) Wang,(13) and others, that the nests are made of substances from the salivary secretions of the birds themselves. In shape the nest may be compared to one side of a boat cut longitudinally at the bottom. Stuart Baker(12) describes the nest of a *Collocalia francica* as "of pure white semitranslucent inspissated saliva, half-cups stuck up against the sloping roofs of small caves round the coast." He also said that it looks like a half saucer of fine strings of isinglass, all matted and half matted together. It presents two surfaces, two edges, and two ends. The surfaces are concave inside and convex outside, while the edge stuck against the wall is thicker than the opposite outer edge. The two pointed ends are drawn upward and slightly inward. A completely built nest weighs about 7 grams,[3] but a complete nest is very rarely collected.

Two types of nests are found in the same cave. Because of their color they are grouped into white and brown nests, or first and second-class nests, respectively. Several suppositions exist concerning these nests. It is believed that the secretion is normally white. Repeated poaching of white nests, however, results in the exhaustion of this white secretion, and the inferior brown nests are later produced. Another supposition is that the brown color of the nest is due to age. It is also believed that the white and brown nests are built by distinct species of swiftlets. The *boceadores*, or nest gatherers, of Bacuit, how-

[3] The weight was obtained a few days after collecting, as practiced in Bacuit.

ever, are unanimous in the opinion that the brown nests are obtained in very deep parts of the cave in the same colony where the white nests are secured. The color, according to them, is due to the soot of the torch which cannot escape. It is thus obvious that brown color is also largely due to age; older nests being subjected to more soot than newer ones. According to the collectors repeated gathering of the nest does not disturb the bird much, for in exactly the same place a new nest of the same nature is constructed. In other caves, however, *Collocalia marginata* were collected. Their nests are of no commercial value, as they largely consist of dark mossy materials held together by a scanty gelatinous substance. This nest and the bird that builds it are known to the natives as *cula cula.*

During the period in which the species was under observation, no eggs were obtained, as the nests were continuously collected. For this reason no authentic description of the egg can be given here. According to the collectors, however, two white eggs comprise the full complement.

In Bacuit *Collocalia francica germani,* the swiftlet that builds edible nests, can readily be distinguished from other forms by its movements. As soon as it leaves the cave the tendency of its flight is upward, whereas other swiftlets either come lower or fly in the immediate neighborhood of the cave. This tendency of the edible-nest builder makes it extremely difficult to secure specimens of this species. In the early morning and the late afternoon, however, thousands of the other species of swiflets can be seen flying close to the ground.

EDIBLE-NEST INDUSTRY IN BACUIT

GOVERNMENT PARTICIPATION

Collecting birds' nests has been a source of livelihood of many people in Bacuit for as long as the residents can remember. Previous to the year 1919 the municipal government of Bacuit recognized the right of any claimant of a cave or caves. The exclusive right of the owner to the nests in his caves was an unwritten law. The period of ownership was indefinite, in fact, ownership came to be handed down from generation to generation. The owner of the caves could sell to anybody the right to collect the nests in his caves. The collector, on the other hand, whether he may be the owner or not, paid the municipal government an annual license fee of 50 centavos.

The nests collected were sold to the local dealers. The business became very lucrative, giving rise to competition among local dealers. As a consequence this condition, which had existed for generations, ceased in 1919 when the provincial board of Palawan passed an ordinance affecting the edible-nest industry. A proviso granting the exclusive privilege of gathering edible birds' nests under a municipal license was adopted. This ordinance was the nucleus of Act No. 3379, otherwise known as "An Act Authorizing Municipalities or Municipal Districts to Impose License Taxes on or Let the Privilege of Gathering Edible Nests Therein, and for other purposes" passed by the Philippine Legislature December 3, 1927. Section 1 of this Act provides that:

> Municipalities or municipal districts shall have authority, within their respective territorial jurisdiction, to impose municipal license taxes on the privilege of collecting edible birds' nests at rates fixed by ordinance of the council, or to grant the exclusive privilege of gathering edible birds' nests in accordance with the provisions of the general municipal law concerning the letting of fisheries and municipal public utilities: PROVIDED, That this authority shall not be interpreted as empowering said municipalities to regulate the establishment of a close season for the collection of edible birds' nests or to prescribe rules and regulations for the preservation of the lives of such birds and the industry itself, which, by law, is vested in the Secretary of Agriculture and Natural Resources. (See regulation elsewhere in this paper.)

This ordinance introduced a new phase in the industry. The traditional ownership of caves was given up. The collector's license fee was discontinued. Instead, the municipality of Bacuit gives the exclusive privilege to the highest bidder. The amount obtained from the bid is the revenue that the municipality of Bacuit now derives from the edible-nest industry.[4] Among the conditions in the rights of the concessioner is that all collectors of edible nests must turn over to him the nests collected within the territorial jurisdiction of the municipality of Bacuit. For some time the ordinance provided a good income to the municipality, as local dealers were in competition. In 1927 Mr. Joaquin Vasquez, of Bacuit, wrote the late Doctor Worm that the municipality derived 1,700 pesos annually from this industry. Later, however, the dealers, all Chinese, formed a corporation and thus eliminated competition. They run their own store in Manila. As a result the bid in 1932 was 575 pesos,

[4] Before this paper went to press, news was received that traditional ownership was restored as nobody submitted a bid for 1937.—C. G. M.

the amount imposed by the municipality as the minimum acceptable. In 1936 the bid was 500 pesos. Whether this decrease in revenue is accompanied by a corresponding decrease in the number of nests collected cannot be ascertained, although on one occasion the concessioner intimated to municipal officials that the annual yield of nests had been increasing. There is no provision in the ordinance in force to enable the municipal authorities to determine the annual yield of the nests. The writer was unable to obtain information about the annual yield of nests, as the concessioner would reveal nothing with regard to this and similar matters. In 1932 A. V. Perez, who stayed in Bacuit for a number of years as Forest Officer in charge, reported that from four islands alone about 420 kilograms of edible nests are collected every year. A rough estimate of 500 kilograms of edible nests from all the islands is considered very conservative. At an average weight of about 5 grams per nest approximately 100,000 nests are collected every year in Bacuit. There is a general feeling in Bacuit that if anyone had been allowed to bid against the corporation now holding a monopoly, the amount collected by the municipality would have been much greater, and the prices paid to the collectors would be higher. A number of residents contemplated participating in the bidding, but were hindered by their unfamiliarity with the business.

THE COLLECTOR AND THE METHOD OF COLLECTING

Under the present arrangement the number of *boceadores,* or nest collectors, cannot be determined. Anybody can be a collector. The concessioner receives all the nests gathered in the caves. This system has often been the cause of trouble among the nest collectors. Poaching or stealing nests by one *boceador* in a cave watched by another is a general occurrence, as the concessioner unquestioningly accepts all nests offered to him. Trouble usually arises in the following manner. When the rain ceases in December the collectors secretly enter their caves to prepare them for the ensuing season. Old nests are collected and the walls of the cave are cleaned to insure an entirely fresh crop. Occasionally old nests are used for commercial purposes. On or about the first week of January the swiftlets begin to build nests. As it takes about three or four weeks to complete a nest, the *boceador* knows that heavier nests can be gathered during the last days of January. Poachers, however, enter caves before that time and collect the nests ahead of the owner. On several occasions the concessioner had to intervene to settle amicably trouble arising under such circum-

stances, especially if the cave owner had come upon the poacher in his cave.

The collection of bird's nests is difficult and risky. A. V. Perez says in his report: "The collection of edible birds' nests is an admittedly hazardous enterprise, in which the collector, known locally as *boceador*, risks his neck, his limbs, and even his life. Only a few caves are easily accessible, and such caves are devoid of bird population. Most of the caves are reached only by painful and patient crawling, inch by inch to reach a ledge, then jump across some deep chasm or ravine, filled with sharp pointed rocks. Some of the caves are on the perpendicular faces of cliffs rising sheer out of the sea. Such caves are entered into after a painful and dangerous climb to the top, after which the collector lowers himself into the cave hand over hand on the rope."

The collector on entering a small cave oftentimes has to use both feet, one or both hands, and his back, to provide anchorage against certain portions of the wall where there is nothing to stand on. A lighted stick of almaciga [5] is used as a torch.

RELATIONS BETWEEN CONCESSIONER AND COLLECTOR

There is a very intimate relationship between the concessioner and the collector, to whom all nests gathered are turned over. Immediately upon collection the collector submits his nests to the concessioner who, as far as residents can remember, always maintains a store of general merchandise. The nests are kept in the possession of the concessioner who takes care of the drying. After a few days, when the nests are almost entirely dirt- and moisture-free, before they are tied together into small bundles (Plate 3) of about 100 grams each, the concessioner calls the collector and either tells him the weight of the nests he collected or weighs the nests in his presence. According to the quality of the nest, which is decided by the concessioner, it costs from 2 to 3½ centavos per gram. In 1927 Doctor Worm noted the price at 5 centavos a gram. As all the collectors are heavily indebted to the concessioner for merchandise, no cash is involved in the transaction. As a gram of edible nest in Manila costs from 7 to 9 centavos, the margin of profit is considerable. The concessioner justifies this high margin of profit by the following considerations: (*a*) He pays 500 to the municipality for concession rights. This fee is payable in advance, in the face

[5] A resin of the almaciga tree (*Agathis alba*).

of uncertainty about the yield for the year. (*b*) He pays a sales tax of $1\frac{1}{2}$ per cent. (*c*) He pays for the shipping. (*d*) He furnishes long-time credit to collectors for the goods they obtain from his store throughout the year and, as many collectors cannot pay him, several thousand pesos of his capital is tied up. (*e*) The price he can obtain in Manila is uncertain.

CONSERVATION: LEGAL AND NATURAL

In an industry like that of edible bird's nests laws and regulations for the conservation of the producing species should be a primary consideration. The collector bent on collecting everything for himself is not concerned with what might happen to the generations to come. Moreover, he is perhaps unaware that intensive nest gathering may result in the extinction of the species that provides him his living. Likewise, the concessioner is not interested in the yields for the years to come. He needs all the nests that the collectors can sell him to justify his investment. It is, therefore, up to the government to provide laws and regulations to perpetuate this important property of the land.

Pursuant to the provisions of Act No. 3379, the Department of Agriculture and Natural Resources on May 19, 1932, issued Administrative Order No. 29–1, regulating close seasons for certain species of birds and mammals. Paragraph 6 of this order reads:

> For birds that make edible nests and edible birds' nest,—the period from April first to June thirtieth, inclusive, of each year; *Provided, however,* That during the open season edible birds' nests shall be taken under license duly issued in accordance with Act No. 3379, and that no person or persons shall take, sell, purchase, or have in possession any such nest of less than ten grams weight.

Before the enactment of Act No. 3379, the Municipality of Bacuit had already recognized the necessity of a close season for the collection of birds' nests. The months of May and June were set aside as close season. There was no provision for the size or weight of the nest to be collected. According to many informants, however, the ordinance was not strictly enforced. Poaching was very common. With the enactment of the law, the power to regulate the close season and the prescription of the rules and regulations were turned over to the Department of Agriculture and Natural Resources, now the Department of Agriculture and Commerce. The order quoted

above, prohibiting even the keeping in possession of nests less than 10 grams in weight, must be violated openly, inasmuch as it is very rare to encounter nests weighing 10 grams or more in the possession of the concessioner. It is obvious that the prescribed regulation refers to the weight of the nest at the time of collecting. In any event the defeat of the "weight provision" is evident. This is perhaps one of the reasons of the municipal officials' indifference to enforce this order. As a result the *boceadores* are following the old ordinance, with a close season only in May and June, without being apprehended. It is, therefore, necessary that an understanding should be reached between the insular and municipal officials in order that existing rules and regulations should be enforced. Fortunately, in spite of the nonenforcement of the present laws and regulations the species has been holding on. The concessioner and some other people in Bacuit even contend that the number of nests collected has increased from time to time. A natural factor for the perpetuation of the species was discovered by the late Doctor Worm. The presence of many small cave openings in very dangerous cliffs (Plate 3, fig. 2) have saved the industry from being ruined. Collectors do not dare enter these caves in spite of the fact that thousands of these birds are seen going in and out. Records of persons who dared enter these caves and were killed there are fresh in the minds of many residents, and cause the collectors to fear entering the valuable caves.

SUMMARY AND CONCLUSIONS

1. The swiftlet that builds edible nests in Bacuit, Palawan, is *Collocalia francica germani* Oustalet.

2. This swiftlet builds its nest in caves. There are many of these caves in the limestone rocks that characterize several islands under the jurisdiction of the municipality of Bacuit.

3. The size of caves varies from small ones inhabited by about twenty pairs of swiftlets to large ones whose occupants have not been determined.

4. The walls of the caves are provided with convexities, concavities, and protuberances. Their surfaces, however, are smooth.

5. Generally, nests are attached against the upper end of a concavity.

6. In shape a nest may be compared to a boat cut lengthwise at the bottom. A complete nest weighs about 7 grams a few days after collecting.

7. Two types of edible nests are obtained in the caves of Bacuit, white and brown, the latter being found in very deep caves. The brown color is due largely to age.

8. In some caves are found only nests of another swiftlet, *Collocalia marginata* Salvadori, called *cula cula* by the natives of Bacuit. These nests are not valuable.

9. By its flight, which is upward from the cave opening, *Collocalia francica germani* is distinguished from other swiftlets by the natives.

10. Collecting nests has been a source of livelihood to many residents of Bacuit, since time immemorial.

11. Previous to 1919 traditional ownership of caves by certain families was respected. Each collector paid the municipality 50 centavos annually for a license.

12. In 1919 a provincial ordinance was passed, declaring all caves government property and empowering the municipal government with granting exclusive privileges of collecting edible nests to the highest bidder. This became a law known as Act No. 3379.

13. Since then the revenue derived by the municipality for exclusive privileges has decreased from 1,700 pesos in 1927 to 500 pesos in 1936.

14. Approximately 500 kilograms of edible nests, or about 100,000 nests, are gathered from the caves within the territorial jurisdiction of Bacuit every year.

15. Poaching of nests is rampant and very often causes trouble among *boceadores,* or nest collectors.

16. The collection of birds' nests is difficult and risky.

17. An intimate relationship exists between the concessioner and the nest collectors. No cash is involved in the edible nest industry in Bacuit. The concessioner owns a store of general merchandise and supplies the collectors' needs throughout the year. The concessioner determines the price of the nests turned over to him and balances it against the goods he supplies the collector. In 1927 the concessioner paid 5 centavos a gram; in 1936 the price ranged from 2 to 3½ centavos.

18. Due to lack of a definite understanding between the insular and the Bacuit municipal governments the existing rules and regulations for the protection of the species are not enforced.

19. Cave openings situated in very dangerous cliffs provide natural protection for the species and the perpetuation of the edible-nest industry in Bacuit, Palawan.

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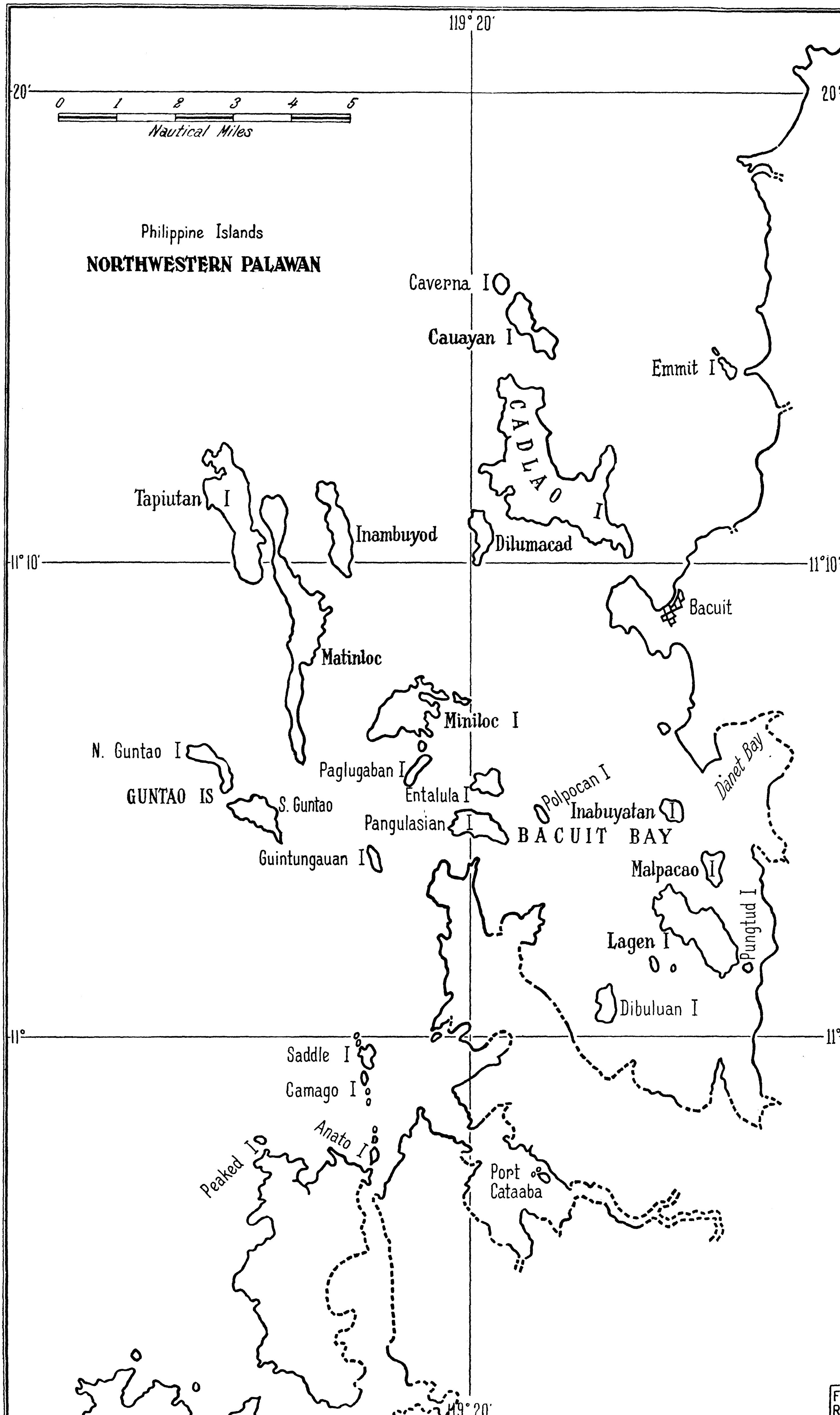
ILLUSTRATIONS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Bacuit
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Paglugaban I
Entalula I
Polpocan I
Inabuyatan I
Danet Bay
Pangulasian I
BACUIT BAY
Guintungauan I
Malpacao I
Pungtud I
Lagen I
Dibuluan I
11°
Saddle I
Camago I
Anato I
Peaked I
Port Cataaba
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PLATE 1

PLATE 2.

PLATE 3.

HETEROPHYIDIASIS, V [1]

OVA IN THE SPINAL CORD OF MAN

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TWO PLATES

Encouraged by our success in finding heterophyid ova associated with chronic specific lesions in the brain(2) identical with those reported by us(3) in the myocardium of persons the majority of whom died of cardiac failure, we extended our search for these eggs to the spinal cord in autopsy cases with evidence of heterophyid infestation. We have succeeded lately in finding heterophyid eggs in lesions in the spinal cord of a case of sudden death due to heart failure. In this case, adult *Heterophyes brevicæca* and *Monorchotrema taihokui* were recovered from the small intestine, and extensive lesions showing ova quite identical to the lesions we have already described in previous publications were observed in the myocardium. This report will deal chiefly with heterophyid infestation in the spinal cord, which, so far as we know, is being published for the first time.

REPORT OF CASE

B. Q., male Filipino, 44 years old, single, bricklayer, born in Batac, Ilocos Norte, but residing in Manila, was found dead in one of the streets of this city, May 18, 1936, and autopsied in the city morgue on the same day. No clinical data could be obtained from a brother who identified the cadaver. The following were the post-mortem findings: Hypertrophy and dilatation of the heart; sclerosis of coronary vessels; distention and congestion of lungs; congestion of liver, spleen, and kidneys; meningeal hæmorrhage, basal extensive. Parasitological findings: Twenty-three adult specimens of *H. brevicæca* and 11 *M. taihokui* were recovered from the scrapings of the small intestine; sections of the myocardium taken from the apical region near the

[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

interventricular septum revealed extensive lesions with eggs typical of cardiac heterophyidiasis; sections of the spinal cord in the lower and upper segments of the dorsal and lumbar cord respectively revealed islands of circumscribed, compact, specific reactive tissue and hæmorrhagic areas punctuated with eggs at various levels of the damaged cord. Extensive search for similar lesions in the brain was unsuccessful.

PATHOLOGICAL ANATOMY

Gross pathology.—On opening the spinal canal the dura mater from the level of the 5th dorsal to the 3rd lumbar segment was covered with a continuous adherent blood clot. The rest of the spinal cord appeared normal. The subdural space in this portion of the spinal cord was also filled with adherent blood clot, corresponding in extent to the hæmorrhage in the epidural space. The vessels of the arachnoid and pia maters in this region were very congested, and there was marked œdema on the left external surface of the intumescentia lumbalis. When the spinal cord proper was freed from the pia mater and from the septum anterius and the ligamentum denticulatum, there was noticed on the surface of the left lateral column in this region a dark-brown line of about 1½ mm maximum width, running parallel with the long axis of the cord, beginning at the level of the 7th dorsal segment where it was most conspicuous, and diminishing gradually posteriad until it became imperceptible at the level of the second lumbar. Macroscopic examination of transverse sections of the cord in this region revealed in the left lateral column a wedge-shaped, dark-brown lesion of about 1½ mm maximum breadth, with its base towards the left anterior horn of the gray matter which it slightly encroached upon in several levels, and its apex directed toward and reaching as far as the lateral margin. This lesion corresponded to the dark brown longitudinal line observed on the free surface of the left lateral column mentioned above.

Histopathology.—Examination of representative sections taken at different levels of the spinal cord, where the lesion is grossly apparent, reveals the following histological changes: The lesion is more prominent and extensive at the level of the 8th dorsal, maintaining the extent uniformly down to the 12th dorsal and from that point gradually diminishing until at the level of the first lumbar the lesion is reduced to one half. The involvement of the cord microscopically gradually disappears lower

down where the hæmorrhagic streak on the surface of the cord ends.

The lesions are moderately quite acute and, as in lesions reported previously from other organs, consist of marked capillary injection, perivascular and interstitial œdema, capillary thrombosis, multiple capillary hæmorrhages, degeneration and rupture of the nerve cells and tissues of the gray substance, and mechanical distortion of the neighboring tissues due to pressure of extravasated blood. The hæmorrhages, while confined to a great extent in the gray matter and axial in distribution, can be seen frequently to extend in small tracts across the white matter, sometimes reaching the periphery, either laterally involving the lateral column or dorsally the columns of Burdach and Goll.

Histologically the lesions are pronounced on the left half of the cord involving the entire gray matter and located mainly in the anterior horn, but also encroaching slightly on the posterior. A large zone of white matter laterally adjacent to the gray tissue is also affected. The portion of the cord showing these histological changes corresponds to the half of the cord which grossly shows the hæmorrhages on the surface.

The most prominent and extensive lesions are located in the portion of the gray matter. The hæmorrhagic processes have extensively destroyed more or less gray tissue in the immediate vicinity in an eruptive manner, creating in the section gaps or spaces partially or fully filled with granular tissue debris or spilled red blood and white cells. The destruction of tissue must have been due to both sudden loss of blood and mechanical pressure caused by the extravasated blood.

In the anterior horn the lesions dissect the nervous tissue up to near the surface of the cord. In the latter location where most of the eggs are found in the hæmorrhagic area the lesions are more cellular and compact with less admixture of red cells and destroyed tissue, and assume more the appearance of the typical specific reactive lesion observed in the brain(2) and heart,(3) and which is observed also in the heart of this case. In the same segments of the affected side of the cord, which show extensive hæmorrhages in the anterior horn, are found definitely circumscribed islands of compact specific reactive tissue located entirely in the white matter. Compared with the brain and cardiac lesions previously described, the specific tissue reaction observed here is rather loose, although proliferated en-

dothelial cells and histiocytes can be distinguished, which, however, have not assumed the characteristic compactness of cellular arrangement shown by more chronic and older lesions.

The character of the specific tissue reaction in this case is that of a lesion of much more recent date. The most recent lesion here is more centrally located in the spinal gray tissue where purely hæmorrhagic lesions can be found. These facts harmonize with our opinion that eggs imprisoned in the reactive tissues can best be seen in the older lesions, because they are caught in the compact tissue and therefore difficult to dislocate, whereas in the more recent, purely hæmorrhagic, lesions, where the tissues are loose, the eggs are easily dislodged and lost during the technical preparation, unless they are present in exceptional abundance.

The eggs encountered in the lesion are few and far apart. In the examination of the whole series comprising the different blocks prepared from this case, there was no instance when more than one egg could be demonstrated in one serial plane. Judging from their size alone, two types of eggs can be demonstrated, a small one corresponding to *H. brevicæca* and a larger one corresponding to *M. taihokui.*

REMARKS

The present findings make the heterophyids the second group of flukes eggs of which have been definitely established as occurring in the spinal cord, since Ferguson (1913) has already encountered eggs of *Schistosoma hematobium* in the brain and spinal cord of a case that died of urinary schistosomiasis, and Mueller and Stender (1930) have reported a case of transverse myelitis involving eggs of *Schistosoma mansoni.*

In four of the five cases of cardiac failure reported by us in a previous publication,(3) in which physical examination could be made, the knee jerk was found absent. In a few cases were also observed numbness and formication in the extremities. The character and extent of the lesion in the spinal cord of the present case may reasonably be associated with loss of this function, especially if the lesion happens to be located in the right area and at the right level to interfere with the function of the different nerve tracts of the cord or with the function of the motor and sensory neurons. It would have been extremely interesting had the subject been observed before death, since, judging from the location, extent, and nature of this lesion, there

ought to be disturbances referable to this condition during life. Unfortunately the sudden and dramatic termination of the disease in the present case made it impossible to obtain data pertaining to this problem.

SUMMARY

The occurrence of heterophyid ova in the intumescentia lumbalis of the spinal cord, associated with lesions similar to those observed in the brain described in a previous publication by the same authors, is reported in this paper.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Photomicrograph (low power) of a section of the spinal cord at the level of the 10th dorsal, showing (*A*) extensive hæmorrhages in the left anterior horn of the gray matter, and (*B*) a definitely circumscribed island of compact, specific, reactive tissue characteristic of heterophyidiasis located in the lateral column of the white matter immediately adjacent to the anterior horn.

2. Photomicrograph (high power) of a section of the spinal cord at the level of the first lumbar, showing an egg (marked *X*) in a hæmorrhagic spot in white matter just outside the left anterior horn. Note the histiocytes and endothelial cells that have appeared on the scene, intermixed with red cells and a few leucocytes. If this lesion is traced serially upwards, it will be found to be continuous with the island of compact, specific reactive tissue shown in Fig. 1 of this plate.

PLATE 2

FIG. 1. Water-color reproduction of the section that appears in Plate 1, fig. 2.

2. Water-color reproduction of a section of the spinal cord at the level of the 12th dorsal, showing islands of definitely circumscribed, compact, specific reactive tissue located in the lateral column of the white matter.

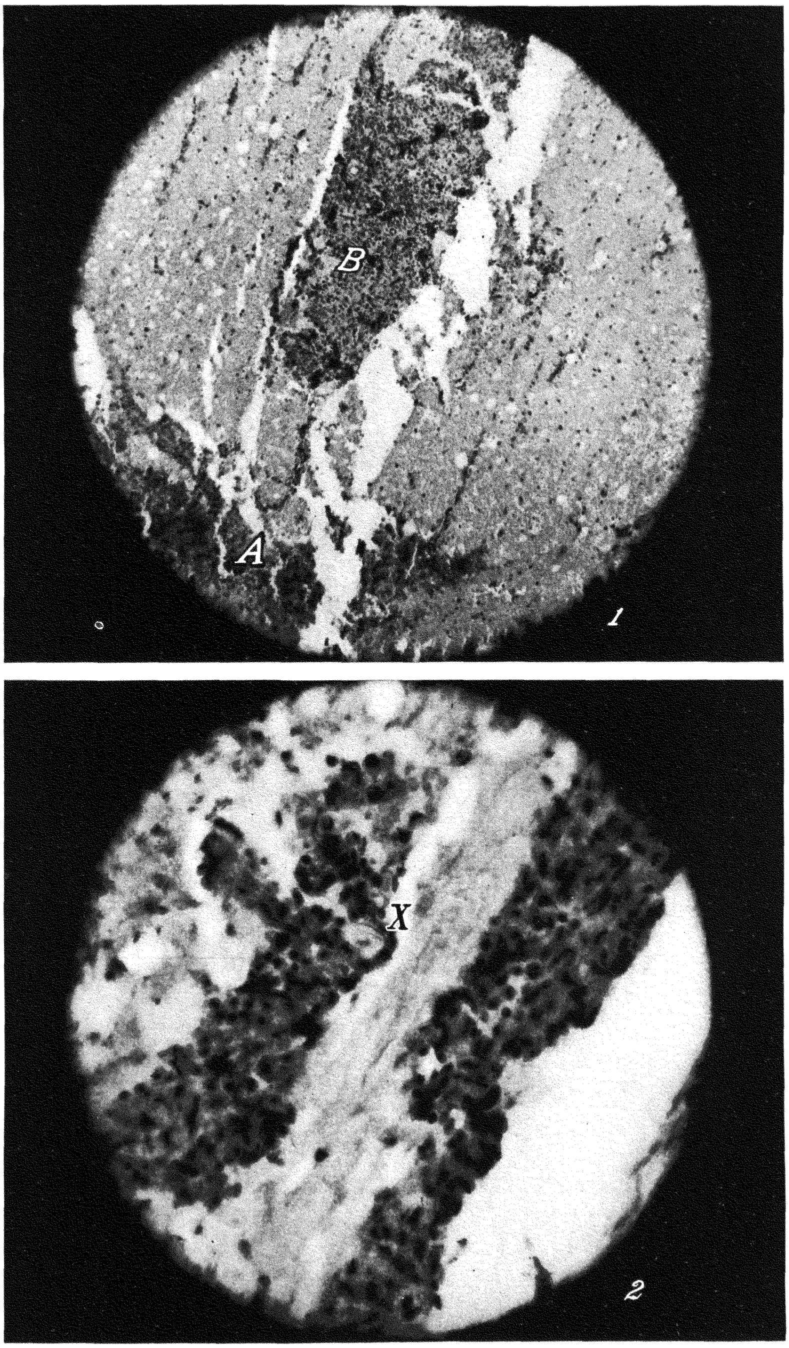
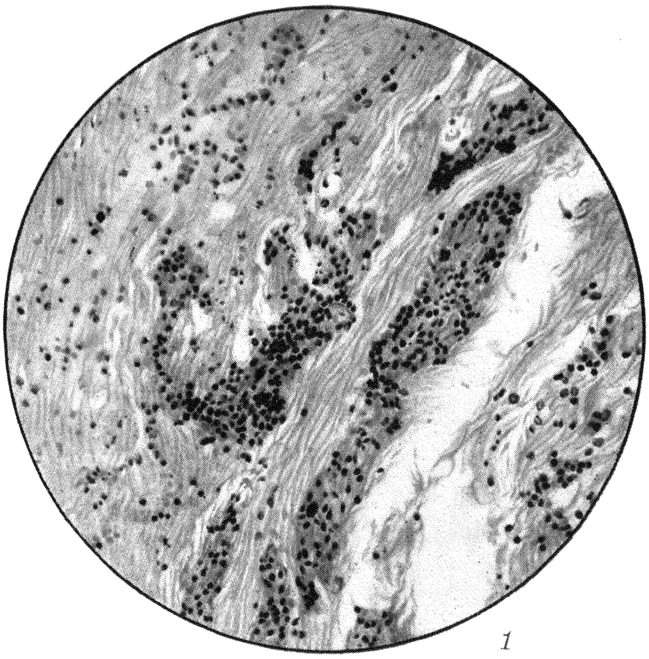


PLATE 1.



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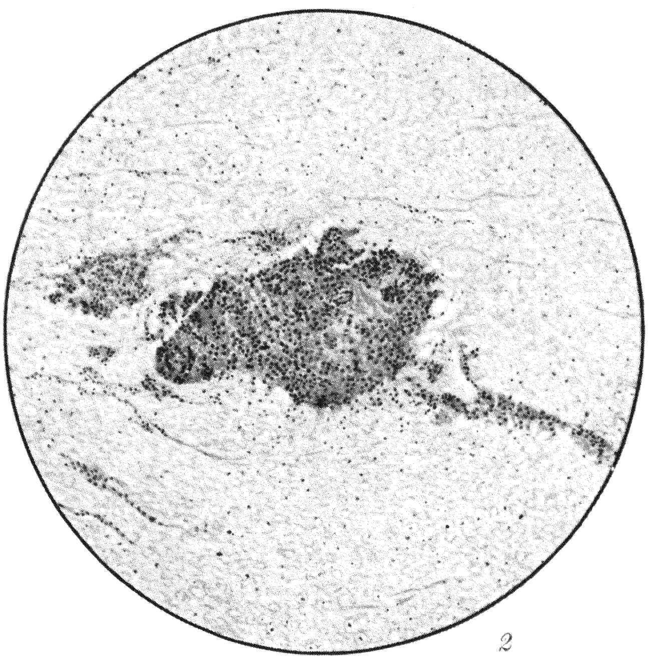

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PLATE 2.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American medical association. Council on pharmacy and chemistry. Glandular physiology and therapy; a symposium prepared under the auspices of the Council on pharmacy and chemistry of the American medical association. Chicago, American medical association, 1935. 528 pp., illus. Price, $2.50.

American society for testing materials. Symposium on industrial fuels. Philadelphia, American society for testing materials, 1936. 70 pp., tables, diagrs. Price, $0.75.

BARBER, G. O. School education in hygiene and sex; lectures given at Felsted school, by G. O. Barber with an introduction by the Rev. Julian Bickersteth and foreword by Sir Humphry Rolleston. Cambridge, England, W. Heffer & Sons, 1936. 71 pp., fold. plate. Price, 2s., 6d.

BARY, P. Le caoutchouc. Preface de G. Urbain. 12th ed. Paris, Dunod, 1936. 346 pp., illus., tables, diagrs.

The British plastics year book, 1936; the handbook and guide to the plastics industry. London, The Plastic press, ltd., 1936. 582 pp., illus., tables, diagrs. Price, 15s.

CHOPRA, R. N. A handbook of tropical therapeutics. Calcutta, Art press, 1936. 1748 pp., tables. Price, Rs 25.

Construction costs. New York, Engineering news-record, 1936. 128 pp., illus., tables, diagrs. Price, $1.

CRISTOL, PAUL. Precis de chimie biologique medicale. Paris, Masson et cie, 1935. 638 pp., tables, diagrs. Price, 80 fr.

DUTAUD, HANNAH. The glorious art of home cooking; how to plan, prepare, serve with recipes for every need. Chicago, Associated authors, 1935. 282 pp., front., illus., plate. Price, $2.75.

GUGGENHEIM, L. K. Otosclerosis. St. Louis, Missouri, The author, 1935. 212 pp., illus., plates. Price, $6.

HOPKINS, G. H. E. Mosquitoes of the Ethiopian region; I.—Larval bionomics of mosquitoes and taxonomy of culicine larvae. London, Printed by order of the trustees of the British museum, 1936. 250 pp., illus. Price, 15s.

HOWARD, J. H. Handbook for the amateur lapidary. Greenville, South Carolina, J. H. Howard, 1935. 140 pp., illus. Price, $2.

IGELSRUD, IVER, R. J. ROBINSON, and T. G. THOMPSON. The distribution of phosphates in the sea water of the northeast Pacific. Seattle, The University of Washington, 1936. 34 pp., tables, diagrs., map. Price, paper, $0.25.

JERRAM, M. R. K. A text-book on forest management. London, Chapman and Hall, ltd., 1935. 156 pp., tables, diagr. Price, 10s. 6d.

JUDY, WILL. Dog encyclopedia. Chicago, Judy publishing co., 1936. 462 pp., illus. Price, $5.

KOENIG, Dr. E. International bibliography on the problems of blood transfusion and the theory of blood groups 1900–1933. Leningrad, Research institute of blood transfusion, 1935. 226 pp.

LARSON, T. H. Physicians' and surgeons' text-book on endocrinology and ready reference therapy. Los Angeles, California, Chicago college of endocrinology, 1934. 870 pp., illus. Price, $10.

LOEPER, M. Thérapeutique médicale; IX maladies infectieuses et parasitaires. Paris, Masson et cie, 1935. 414 pp., tables, diagrs. Price, 50 fr.

MACFADYEN, (Mrs.) L. M. I. (DEAN). Alcyonaria (Stolonifera, alcyonacea, telestacea and gorgonacea). [British museum (Nat. Hist.) Great barrier expedition, 1928–29. Scientific reports, v. 5, No. 2.] London, Print. by order of the trustees of the British museum, 1936. 53 pp., illus., plates. Price, $1.75.

The 1935 year book of the eye, ear, nose and throat. Chicago, The Year book publishers, 1935. 638 pp., illus. Price, $2.50.

PARMELEE, C. W. Clays and some other ceramic materials, pt. I. Ann Arbor, Michigan, Edwards brothers, 1935. Illus., tables, diagrs.

PRATT, J. D. Gas defence. London, The British science guild, 1935. 18 pp. Price, paper, 1s.

RIESMAN, DAVID. The story of medicine in the middle ages. New York, P. B. Hoeber, 1936. 402 pp., front., illus. Price, $5.

SCHWARZ, E. W. K. Rayon and synthetic yarn handbook. New York, Rayon publishing corp., 1936. 558 pp., illus., tables, diagr. Price, $3.75.

SPERANSKY, A. D. A basis for the theory of medicine. Tr. and ed. by C. P. Dutt with the collaboration of A. A. Subkov. New York, International publishers, 1935. 417 pp., illus., tables, diagrs., plates. Price, $4.

WALKER, H. W. Wanderings among South Sea savages; and in Borneo and the Philippines. Rev. ed. London, H. F. & G. Witherby, ltd., 1935. 245 pp., illus., plates. Price, 7s. 6d.

WHITE, W. A. Twentieth century psychiatry; its contribution to man's knowledge of himself. New York, W. W. Norton & co., 1936. 198 pp. Price, $2.

WISHART, J., and H. G. SANDERS. Principles and practice of field experimentation. London, The Empire cotton growing corp., 1935. 100 pp., tables. Price, paper, 3s.

REVIEWS

Glandular Physiology and Therapy. A Symposium Prepared under the Auspices of the Council on Pharmacy and Chemistry of the American Medical Association. American Medical Association, Chicago, 1935. 528 pp. Price, $2.50.

This work consists of thirty-one articles, written by well-known authorities in the field of endocrinology, like Ascheim,

Zondek, and Novak, and representing the results of investigations conducted in renowned laboratories and hospitals, which have appeared previously in the Journal of the American Medical Association. It seems inconceivable that so much research information on endocrine physiology and treatment could be contained in so small a book. The contributors compiled data and selected only useful and well-tested experimental results. Successes and failures in hormone therapy are given due consideration.

The book is useful as a reference book for researchers and as a therapeutic guide to medical practitioners. A special chapter gives useful information about the physical and chemical properties as well as the therapeutic effects of various commercial gland preparations on the market. A subject index and a table of contents increase the usefulness of the book. It is rather unfortunate, however, that there are no illustrations or pictures of test subjects, for these would have made the book more interesting.—I. F.

Infra-red Irradiation. By William Beaumont, with a forewood by Lord Horder. H. K. Lewis & Co., Ltd., London, 1936. 139 pp. Price, 6s. 6d.

This is a very interesting and instructive book. It emphazises the place of infra-red irradiation in the field of therapeutics, and encourages further research for a broader application of the different rays of the electro-magnetic spectrum. The book will prove especially useful as a guide among general practitioners, and among gynecologists and obstetricians in particular.—A. V.

Birth Control; Its Use and Misuse. By Dorothy D. Bromley. Harper Brothers, New York and London, 1934. 304 pp. Price, $2.50.

This well-written, readable, and straightforward book on a controversial subject—especially in our midst—is indeed fortunate and timely. It should be read by many, for it would surely open the minds of those who are prejudiced against the subject of controlled conception to a broader viewpoint and provide those who are sympathetic with a source of valuable information. The chapter on Spacing of Children gives valuable information that pediatricians and obstetricians ought to bear in mind if they are interested in the welfare of mothers and children. The good discussion on the treatment of sterility rounds out the book and makes it well-balanced.—U. D. M.

Nutrition in Health and Disease for Nurses. By Lenna F. Cooper, Edith M. Barber, and Helen S. Mitchell. 6th ed., rev. and reset. J. B. Lippincott Co., Philadelphia, 1935. 711 pp., illus. Price, $3.

This book gives a very interesting and instructive account of nutrition in health and disease. It is written in a popular style and is especially suitable for nurses.

The principles of nutrition, food selection and cookery, diet in disease, cooking for the sick and convalescent, and various other aspects of nutrition, are well presented.

Various metabolic and deficiency diseases, including the newer views of dietary treatment, are discussed quite thoroughly.

A number of good recipes are recommended for the sick and convalescent as well as suggestions for serving food.

The book has an appendix that contains valuable data on the classification and nutritive value of foods, tables of weights and measures, and numerous references.—A. J. H.

Kris and other Malay Weapons. By G. B. Gardner. Progressive Publishing Company, Singapore, 1936. 138 pp., illus. Price, 6s. 6d.

This book gives the origin, description, and classification of the Malay kris and legends and superstitions connected with it. It also describes other Malayan weapons, such as daggers, swords, spears, cannons, and bows and arrows. It is a concise and comprehensive book which may be of interest to students of ethnography and collectors of Malayan weapons.—R. E. G.

Land Planning. By Lewis C. Gray. University of Chicago Press, Chicago, 1936. 37 pp. Price, $0.25.

At present, when the question of land utilization, particularly with reference to the distribution of public domain as a policy of the Commonwealth Government, is paramount in the minds of Filipino statesmen, it is timely that we have up-to-date discussion on land use. Land planning is a great help to those who are interested in the distribution of public domain.

The book emphasizes the principles involved in the proper utilization of land. An elucidating review of land policies in the United States, both past and present, is given. The discussions of the factors influencing land requirements, such as the growth of population, industrial outlook, land utilization, changes of diet, international trade as affecting land use, the prospect of increased productivity and efficiency, the need for reduction in crop lands, the agricultural land resources, the forest land requirements and its effects on agriculture, the land required for recreation and for wild life, should be of great use

to the leaders of the nation interested in legislation governing the distribution of the public domain. The recommendations are timely suggestions to the Commonwealth Government and are strong arguments for establishing in the Philippines a definite land program.—H. S. S.

Parents and Sex Education for Parents of Young Children. By Benjamin C. Gruenberg. 3d rev. ed. The Viking Press, New York, 1932. 112 pp. Price, $1.

This comprehensive little book is rich in suggestions to parents for handling the most delicate but important educational problem of young children. Frank and truthful instruction about sex facts is advocated. In the Philippines, where vulgarity among parents is not uncommon and sex knowledge among the older and younger generations of parents is practically negligible, this book should fill a great need. It should be read and reread by parents to enable them to help their growing children solve their new sex problems.

This book forms good supplementary reading to child study books for teachers, social workers, and those engaged in boys' and girls' work, and will enable them to coöperate with parents in the solution of their children's problems.—U. D. M.

Birth-control Methods (Conception, Abortion, Sterilization). By Norman Haire. With a foreword by Aldous Huxley. George Allen & Unwin, Ltd., London, 1936. 192 pp., illus., plates. Price, $1.75.

Birth-control Methods, by Norman Haire, is a comprehensive little handbook on the subject. It discusses in a clear way all the known methods being used and their merits. It goes into detail about the use of silver rings as an intra-uterine contraceptive which is extensively used in Germany and England. This method has not been used to any extent in the United States. He claims it is less effective than the vaginal diaphragms and necessitates the service of an experienced gynæcologist. However, it has the advantage of being less bothersome, which most women would rather prefer. The book is easy to read and would be handy for those who have little time to read more extensive treatises on the subject.—U. D. M.

The Human Foot; its Evolution, Physiology and Functional Disorders. By Dudley J. Morton. Columbia University Press, New York, 1935. 244 pp., plates. Price, $3.

Apparently this book would be most useful to orthopedic surgeons, although it would certainly be of great interest and value to physicians, anatomists, and anthropologists. What would

prove useful to the orthopedist is the comprehensive discussion of the various functional disorders of this part of the lower extremity of the body, as well as the means of their diagnosis and methods of treatment. But interesting to all will be the historical account of the evolution of the foot from a mere grasping appendage among the early ancestors of man to its present complex form.

The author deplores, and with reason, the commonly observed fact of the indifference of the public in general toward realizing the significance of foot-disorders and the need of having them medically attended to. In so far as it will go in correcting this condition and reducing the number of those cases, which for lack of proper treatment give rise to disagreeable results, this book would be useful.—J. S.

Practical Clinical Psychiatry for Students and Practitioners. By Edward A. Strecker and Franklin G. Ebaugh. 4th ed. rewritten and enl. P. Blakiston's Son & Co. Inc., Philadelphia, 1935. 705 pp., illus. Price, $5.

The book is a concise presentation of the subject of psychiatry as it has been developed in the last three decades in America. The individual mental diseases, throughout the book, are considered as definite mental reactions, each mental reaction having been gradually generated and evolved by a definite set of psychobiological causations.

The psychobiological conception of mental disorders as originally announced by Adolf Meyer, professor of psychiatry of the Johns Hopkins Medical School, has been adhered to by the authors. What this conception on mental disorders is may be understood in the following paragraph, which is quoted from the first chapter of the book.

"The psychobiological conception begins by advancing the hypothesis that all of the activities of an individual should be studied in relation to each other in a particular setting. Where strictly organic lesions can be demonstrated these should be evaluated and treated in relation to the whole picture. Where psychogenic causes are the predominant features in the etiology these should be studied, beginning with the origin, if possible, and studying successive phases in development up to the present picture, since it is believed that mentation operates according to certain laws which are fixed as the laws of physics, and it fol-

lows that these laws operate alike for the mentally ill as for the mentally sound. No distinct identity is accorded to the so-called 'mind' since the concept of the latter was only artificially created to explain the 'mind-function' which depends upon inherited structures, and physiological processes like metabolism, oxygenation, etc., but both structure and physiological functions are modified from conception by the forces of environment through home, school, family and community, occupational, religious, recreational, economic and sex requirements. The 'minding-function' emerged as a new quality in the evolutionary process but is intimately related to all the biological processes which gave rise to it. Hence, everything that went into making a man is a part of his personality, and is consequently related to any disorder of that personality."

The psychobiological conception, therefore, urges us to maintain a pluralistic view regarding the etiology of mental disorders, and cautions us against the rigid belief in the inheritability of mental disease, inasmuch as the percentage of mental disease in tainted families is only slightly higher than in the general population.

Every mental disorder taken up in the book is presented, not by the old method of just narrating in a fixed and inviolable manner the characterization of the disease, but by the modern, more practical and more effective bed-side demonstration of classical cases. This method has the advantage over the older one in that every case is presented as a distinct individual experiment in nature—a distinct disease process with its peculiar etiology, symptomatology, pathology, course, and prognosis.

The book also brings information on the newly discovered therapeutic agents in the realm of mental diseases; and it emphasizes the fact that in the treatment of any disease it is not the disease process alone that is to be treated, but the whole individual, the entire personality, that presents the abnormal reaction. This brings to us the consideration of the fact that even in any somatic disease the constitutional personal element of the individual and his psyche play their parts in the disease picture; and that certain mental or emotional conflicts can produce definite physical disturbance or disfunction. In the chapter on psychopathological problems of childhood the writers have demonstrated among children cases of psychogenic constipation, enuresis, and tics.

The book, which has eleven chapters, is written in an easily understandable manner. It would be a good textbook in any medical school and should be read, not only by those who are interested in mental diseases, but also by the lay public because of the mental hygiene principles that are mentioned in it, especially in the last chapter.—T. J.

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TAPEWORM PARASITES OF PHILIPPINE BIRDS

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Of the Bureau of Science, Manila

SEVEN PLATES

The Philippine cestode fauna is very imperfectly known, only the more common tapeworms infesting rats, domesticated mammals, and chickens having been reported. For this reason it was decided to study the collection of the Philippine Bureau of Science, which includes many specimens donated by members of the Fish and Game Administration. We wish to take this opportunity to express our indebtedness to this Division, especially to Dr. C. Manuel and Mr. F. Rivera, for their keen interest in collecting parasitological material from birds and other game animals.

Order CYCLOPHYLLIDÆ

Family ANOPLOCEPHALIDÆ Cholodkovsky, 1902

Genus APORINA Fuhrmann, 1903

APORINA DELAFONDI (Railliet, 1892) Baer, 1927. Plate 1, figs. 1, 2, and 3.

This is a widely distributed parasite, having been reported from different species of pigeons in various parts of the world. The Philippine specimens (No. 168) agree in all essential details with the descriptions of the worm as given by Fuhrmann (1902) and Southwell (1930), except in the following: (*a*) the cirrus sac is 0.22 to 0.28 millimeter long and extends slightly internally to the ventral longitudinal excretory vessel on the poral side; (*b*) the testes are 94 to 126 in number, occurring in two unequal groups, one on each side of the vitelline gland.

Host.—*Streptopelia dussumieri.*[1]
Location.—Intestine.
Locality.—Sitio Lumaba, Villaviciosa, Abra, Luzon.

Family DAVAINEIDÆ Fuhrmann, 1907

Genus RAILLIETINA Fuhrmann, 1920

Subgenus RAILLIETINA Stiles and Orleman, 1926

RAILLIETINA (RAILLIETINA) DAETENSIS sp. nov. Plate 1, figs. 4, 5, and 6.

This tapeworm differs from all the previously recorded members of the subgenus *Raillietina* in the following combination of characters; its very short, thickly-set segments, the lobulated ovary, the number and arrangement of the testes, and the size of the rostellar hooks.

External anatomy.—Maximum length 175 millimeters, maximum breadth 3.7 millimeters in region of mature proglottids. All segments much broader than long, except the most posterior ones which are bell-shaped and measure 0.85 by 1.15 millimeters. Head about 0.4 millimeter in diameter, separated from rest of body by a neck 1 millimeter long. Rostellum 0.08 by 0.13 millimeter in size, armed with 190 typical hammer-shaped hooks 23 to 31 microns long, arranged in two rows, the hooks in the anterior row larger than those in the posterior row. Suckers 0.09 to 0.10 millimeter in diameter, each armed with numerous hooklets 11.5 to 14 microns long, arranged in 6 to 7 rows. Genital pores unilateral, near middle of lateral margins of segments.

Musculature.—Longitudinal muscles arranged in two layers: a thicker outer layer of numerous irregular rows of small bundles of fibers and a thinner inner layer composed of one row of about sixty larger bundles. The dorsoventral and circular muscle fibers are fairly well developed.

Male genitalia.—Testes 12 to 15 (usually 14) in number, 60 to 95 microns in diameter, arranged in two unequal groups on each side of ovary, 5 to 7 being on the poral and 7 to 10 on the aporal side. Vas deferens very loosely coiled, extending almost transversely from cirrus sac to near median line and surrounded by only a few prostatic cells. Cirrus sac relatively small, 0.17 to 0.20 by 0.06 to 0.07 millimeter, not reaching longitudinal nerve; its cavity occupied by cirrus which is dilated and armed with hairlike spines.

[1] The scientific names of the bird hosts are as given by McGregor (1909).

Female genitalia.—Ovary asymmetrically bilobed and lobulated, each lobe composed of a few follicles; it has an expanse of 0.5 to 0.7 millimeter and is placed slightly towards the poral side of the segment. Vitelline gland small but prominent, transversely oval, 0.04 to 0.05 by 0.09 to 0.14 millimeter, to one side of median line and immediately behind ovary. The vagina is uniformly small in diameter, its terminal portion, which is muscular, opening immediately behind the cirrus into a very small genital sinus. The uterus is first seen as a small sac of the size of, and on the left side of, the vitelline gland; it soon enlarges and breaks into capsules, each containing 4 to 8 eggs. Each gravid segment contains approximately 120 of these egg capsules which are confined between the excretory vessels. No mature eggs were seen.

Specific diagnosis.—*Raillietina* (*Raillietina*): Length 175 millimeters, maximum breadth 3.7. Rostellar hooks 190, 23 to 31 microns long. Genital pore near middle of lateral margin of segment. Cirrus sac not reaching longitudinal nerve. Testes 12 to 15, 5 to 7 poral and 7 to 10 aporal. Ovary asymmetrically bilobed and lobulated, towards poral side of segment. Gravid segment with about 120 egg capsules, each containing 4 to 8 eggs.

Host.—*Treron* sp.

Location.—Intestine.

Locality.—Daet, Camarines Norte, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 333.

RAILLIETINA (RAILLIETINA) SEQUENS sp. nov. Plate 2, fig. 1.

Columbiform birds have been reported to be infested with several species of the subgenus *Raillietina,* which have the common characteristic of possessing not more than ten testes in each segment. The parasite in question as well as the one described below belongs to this group, the other principal characters of the members of which are given in Table 1. *R. sequens* bears the greatest resemblance to *R. quadritesticulata* Moghe, 1925, *R. flaminiata* Meggitt, 1931, and *R. torquata* var. *rajæ* var. nov. (see description below), differing from them only in the number and arrangement of the testes and in the number of egg capsules in each gravid segment.

External anatomy.—Maximum length 170 millimeters, maximum breadth 1.1 millimeters in region of gravid segments. Segments much broader than long except posterior gravid segments, which are bell-shaped to squarish and measure 0.4 to 0.7

TABLE 1.—*Comparison of species of Raillietina (Raillietina) parasitic in Columbiformes and possessing not more than ten testes in each segment.*

Species.	Size.		Rostellar hooks.		Length of hooks on suckers.
	Length.	Maximum width.	Number.	Length.	
	mm.	*mm.*		*µ*	*µ*
R. paucitesticulata (Fuhrmann, 1909)	100	0.6	120	9–10	8
R. spiralis (Baczyńska, 1914)	30–40	1.28	300	16	
R. quadritesticulata Moghe, 1925	62–132 (Meggitt, 1931:320)	0.92–1.23 (Meggitt: 2)	180	6 (Meggitt: 8)	
R. torquata (Meggitt, 1924)	230	2.5	150	7–7.5	8
R. flaminiata (Meggitt, 1931)	50	0.6		9	
R. fragilis Meggitt, 1931	190	0.9		6–9	
R. sequens sp. nov.	170	1.1	180	7.6–8	Probably lost.
R. torquata var. *rajæ* var. nov.	150	1.4	150	7,7	7–7–9.6

Species.	Testes.		Cirrus sac.	
	Number.	Location.	Size.	Extent.
		mm.	*mm.*	
R. paucitesticulata (Fuhrmann, 1909)	6–7 (7–8 Joyeux and Houdemer, 1927; Joyeux and Baer, 1935).		0.112–0.140×0.045–0.060	Not reaching excretory vessel.
R. spiralis (Baczyńska, 1914)	6–7		0.10 long	Do.
R. quadritesticulata Moghe, 1925	4	3 aporal, 1 behind ovary (Meggitt: 4–7).	0.138×0.068	Do.
R. torquata (Meggitt, 1924)	8–10	2 poral, 1 behind ovary, rest aporal.	Small	Reaching only to nerve.
R. flaminiata (Meggitt, 1931)	5–9	2 poral, rest aporal	0.11–0.13×0.04–0.06	Reaching excretory vessel.
R. fragilis Meggitt, 1931	8–9	do.	0.12×0.06	Not reaching nerve.
R. sequens sp. nov.	5–6	1–2 poral, 3–5 aporal	0.10–0.12×0.04–0.06	Halfway between margin and excretory vessel.
R. torquata var. *rajæ* var. nov.	7–10	1–2 poral, 1–3 behind ovary, 3–6 aporal.	0.14–0.16×0.06–0.07	Almost reaching excretory vessel.

Species.	Egg capsules.		Hosts.	Locality.
	Number in each gravid segment.	Number of eggs.		
R. paucitesticulata (Fuhrmann, 1909)		6–8	*Caloenas nicobarica*, *Streptopelia orientalis*, etc.	Malay Archipelago, India, Indo-China, etc.
R. spiralis (Baczyñska, 1914)	Few	4–6	*Columba* sp., *Crocopus phœnicopterus*.	New Guinea, India.
R. quadritesticulata Moghe, 1925	40–50 (Meggitt, 60–100).	6–8	*Œnopopelia tranquebarica*, *Chalcophaps indica*, *Goura coronata*.	India, Burma.
R. torquata (Meggitt, 1924)	30–40	3–5	*Columba* sp.	Burma.
R. flaminiata (Meggitt, 1931)	16	2–6	*Columba punicea*, *Goura coronata*	Do.
R. fragilis Meggitt, 1931	75	4–6	*Columba punicea*	Do.
R. sequens sp. nov.	20–25	2–8	*Streptopelia dussumieri*	Philippines.
R. torquata var. *rajæ* var. nov.	50–60	2–6	Domestic pigeon	Do.

by 0.7 to 0.9 millimeter. Head about 0.1 millimeter in diameter, separated from the rest of body by a neck 0.75 millimeter long. Rostellum 0.06 millimeter in diameter and about as long, carrying about 180 hammer-shaped hooks 7.6 to 8 microns long, arranged in two alternating rows. Suckers 0.04 millimeter in diameter, devoid of hooks, the latter having probably been lost. Genital pores unilateral, at junction of anterior and middle thirds of lateral margins of segments or slightly behind that level.

Musculature.—The musculature is weakly developed. The longitudinal muscles are represented mostly by solitary muscle fibers and a few bundles of two or three fibers.

Male genitalia.—Testes 5 to 6 in number, 1 to 2 poral and the rest aporal, 55 to 70 microns in diameter. Vas deferens moderately coiled, running in parallel direction with vagina to near median line, and surrounded throughout with intensely staining cells (prostate). Cirrus sac 0.10 to 0.12 by 0.04 to 0.06 millimeter, extending only halfway between ventral longitudinal excretory vessel and poral margin of segment. Seminal vesicle small; cirrus armed with very fine hairs.

Female genitalia.—Ovary median, bilobed, with an expanse of 0.15 millimeter; each ovarian lobe about as large as one of the testes. Vitelline gland behind ovary, subglobular to oval, 50 to 70 microns across. Shell gland small, between ovary and vitelline gland. Vagina opens outside posteriorly to cirrus; its terminal portion is provided with sphincter muscle fibers and its proximal end is wider in diameter and probably functions as a seminal receptacle. Egg capsules 20 to 25 in each gravid segment, confined between longitudinal excretory vessels and each containing 2 to 8 eggs. Eggs 38.4 to 46 by 34.5 to 42 microns; onchospheres 19 to 23 microns in diameter.

Specific diagnosis.—*Raillietina* (*Raillietina*): Length 170, maximum breadth 1.1 millimeters. Rostellar hooks 180, 7.6 to 8 microns long. Genital pore in front of middle of proglottis margin. Cirrus sac extending halfway between genital pore and excretory vessel. Testes 5 to 6, 1 to 2 poral and the remainder aporal. Ovary bilobed. Gravid segment with 20 to 25 egg capsules, each containing 2 to 8 eggs 38.4 to 46 by 34.5 to 42 microns; onchospheres 19 to 23 microns in diameter.

Host.—*Streptopelia dussumieri.*

Location.—Intestine.

Locality.—Makatipo, Rizal, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 320.

RAILLIETINA (RAILLIETINA) TORQUATA (Meggitt, 1924) var. RAJÆ var. nov. Plate 2, fig. 2.

As shown in Table 1, this tapeworm is quite similar to *Raillietina torquata* (Meggitt, 1924), differing from it only in the extent of the cirrus sac, the number of egg capsules in each gravid segment, and the number of eggs in each capsule.

External anatomy.—Maximum length 150, maximum breadth 1.35 millimeters in region of gravid proglottids. Segments broader than long, the longest posterior segments measuring 0.75 to 0.95 by 0.92 to 1.05 millimeters. Head 0.15 to 0.17 millimeter across; neck 1 to 2 millimeters long, depending upon state of contraction of specimen. Rostellum 0.05 to 0.07 by 0.08 to 0.10 millimeter, armed with about 150 characteristic hooks arranged in two alternating rows and measuring 7.7 microns in length. Suckers 0.04 to 0.06 millimeter in diameter, each armed with numerous hooks arranged in five rows and measuring 7.7 to 9.6 microns in length. Genital pores unilateral, near center of proglottid margins.

Musculature.—The muscular system is weakly developed, consisting of a very thin inner layer of circular fibers and a thicker outer layer of longitudinal muscles. The latter occur mostly as solitary fibers, bundles of two or three fibers being few. Dorsoventral fibers are fairly numerous.

Male genitalia.—Testes 7 to 10 (usually 8), 1 to 2 poral, 1 to 3 behind ovary and 3 to 6 aporal; testes subglobular to globular in shape, 50 to 60 microns in diameter. Vas deferens moderately coiled, surrounded throughout by prostatic cells and extending to or slightly beyond median line. Cirrus sac 0.14 to 0.16 by 0.06 to 0.07 millimeter, crossing longitudinal nerve but not quite reaching excretory vessel. Seminal vesicle small; cirrus armed with fine hairs.

Female genitalia.—Ovary bilobed, with smooth surface, median or slightly towards aporal side of median line, with an expanse of 0.15 to 0.20 millimeter. Vitelline gland behind ovary, towards aporal side of median line, subglobular, 0.04 to 0.07 millimeter across. Shell gland small, between ovary and vitelline gland. Vagina opening posteriorly to cirrus, its terminal portion provided with sphincter muscles; near ovary it is slightly swollen, forming a small receptaculum seminis. Egg capsules 50 to 60 in each gravid segment, confined between

longitudinal excretory vessels and each containing 2 to 6 eggs. Eggs 42 to 50 by 38.4 to 42 microns, onchospheres 19 to 23 microns in diameter.

Variety diagnosis.—*Raillietina* (*Raillietina*): Length 150, maximum breadth 1.35 millimeters. Rostellar hooks 150, 7.7 microns long. Hooks on suckers 7.7 to 9.6 microns long. Genital pore near center of proglottis margin. Cirrus sac crossing nerve but not quite reaching excretory vessel. Testes 7 to 10, 1 to 2 poral, 1 to 3 behind ovary and 3 to 6 aporal. Gravid segment with 50 to 60 egg capsules, each containing 2 to 6 eggs. Eggs 42 to 50 by 38.4 to 42 microns, onchospheres 19 to 23 microns in diameter.

Host.—Domestic pigeon.

Location.—Intestine.

Locality.—Manila, P. I.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 513.

Subgenus PARONIELLA Fuhrmann, 1920

RAILLIETINA (PARONIELLA) TINGUIANA sp. nov. Plate 2, figs. 3, 4, and 5.

According to Baer (1931) the subgenus *Paroniella* includes the following cestodes infesting Galliformes: *R. facile* Meggitt, 1926; *R. magninumida* Jones, 1930; *R. numida* (Fuhrmann, 1912); and *R. urogalli* (Modeer, 1790). The Philippine species differs from these in the number of its rostellar hooks, which are 320 compared with 160 in *R. urogalli,* 85 in *R. facile,* 150 to 160 in *R. magninumida,* and 160 to 180 in *R. numida;* and in the number and arrangement of its testes, which are 32 to 44 compared with 130 in *R. urogalli,* 9 to 10 in *R. facile,* 13 to 18 in *R. magninumida,* and 7 to 10 in *R. numida.*

External anatomy.—Maximum length 90, maximum breadth 2.3 millimeters in region of young gravid proglottids. Immature and mature segments broader than long; posterior segments squarish or elongated, the longest measuring 2.0 by 1.7 millimeters. Head 0.28 to 0.38 millimeter in diameter, neck 0.5 millimeter in length. Rostellum 0.07 to 0.08 by 0.09 to 0.10 millimeter, armed with 320 hooks arranged in two rows and measuring 8.5 to 10 microns in length. Suckers 0.095 to 0.115 millimeter in diameter, armed with numerous hooks 7.5 to 9.5 microns long. Genital pores unilateral, at junction of anterior and middle thirds of proglottid margins.

Musculature.—The musculature of this species is moderately well developed with the exception of the circular muscular fibers

which are few and inconspicuous, on account of which the parenchyma is not distinctly divided into cortical and medullary portions. The longitudinal muscles are especially prominent in cross sections of immature segments and consist of an inner layer of larger bundles of fibers and an outer layer of smaller bundles, as well as isolated fibers.

Male genitalia.—Testes 32 to 44 in number, 27 to 30 microns in diameter; they are grouped closely together in the form of a crescentic band behind and on either side of the female glands, about two-thirds of their number being on the aporal side of the median line. Vas deferens much coiled, uniform in diameter, surrounded by prostatic cells throughout its length, extending to near the median line. Cirrus sac relatively small, 0.11 to 0.13 by 0.05 to 0.06 millimeter, not even reaching longitudinal nerve. Seminal vesicle small, cirrus unarmed.

Female genitalia.—Ovary bilobed, median, 0.2 millimeter across. Vitelline gland median, behind ovary, small in mature segments; in segments where the uterus begins to form it becomes a conspicuous organ with a diameter of 0.25 millimeter. Shell gland small, between ovary and vitelline gland. Vagina opens posteriorly to cirrus; it is dilated throughout its length and probably functions as a seminal receptacle. Uterus (Plate 2, fig. 5) becomes recognizable early in the form of intensely staining tubules radiating from a center immediately dorsal to the ovary; at this stage of its development it could be mistaken for a lobulated ovary. The tubules gradually increase in length and then break up into egg capsules each containing a single egg. The egg capsules extend laterally beyond longitudinal excretory vessels. None of the gravid segments examined contained mature eggs.

Specific diagnosis.—*Raillietina* (*Paroniella*): Length 90, maximum breadth 2.3 millimeters. Rostellum with 320 hooks 8.5 to 10 microns long. Hooks on suckers 7.5 to 9.5 microns long. Genital pore at junction of anterior and middle thirds of proglottis margin. Cirrus sac small, not reaching longitudinal nerve. Testes 32 to 44, grouped closely in the form of a crescentic band behind and on either side of female glands. Ovary bilobed. Egg capsules extending laterally beyond longitudinal excretory vessels.

Host.—Wild chicken (*Gallus gallus*).

Location.—Intestine.

Locality.—Sitio Lumaba, Villaviciosa, Abra, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 169.

RAILLIETINA (PARONIELLA) CIRROFLEXA sp. nov. Plate 3, figs. 1, 2, and 3.

This tapeworm was obtained from a woodpecker. It is naturally more closely related to *Raillietina longispina* (Fuhrmann, 1909), *R. cruciata* (Rudolphi, 1819) and *R. rhynchota* (Ransom, 1909), which are also parasites of woodpeckers, than to the other members of the subgenus *Paroniella.* It differs from these, however, in the number and position of its testes and particularly in the appearance of its cirrus sac, which is bent anteriorly in such a way that its main axis is parallel with the proglottis margin.

External anatomy.—Maximum length 20 millimeters, maximum breadth 0.8 millimeter in region of mature and young gravid segments. Immature and mature proglottids wider than long; gravid segments bell-shaped to squarish, the longest among them measuring 0.47 by 0.47 millimeter. Scolex 0.3 millimeter across; neck very short, practically absent. Rostellum 0.08 by 0.15 to 0.20 millimeter in size, armed with about 250 hooks arranged in two rows and measuring 10.4 to 11.5 microns in length. Suckers 0.10 to 0.13 by 0.09 to 0.12 millimeter, armed with numerous deciduous hooks 5.8 to 10.4 microns long. Genital pores unilateral at middle of proglottid margins, each leading into a roomy genital sinus.

Musculature.—The musculature is well developed. The longitudinal muscles are arranged, as in most cestodes, in two layers—an inner layer of large bundles and an outer layer of small bundles of fibers. There are also numerous dorsoventral fibers, but only a few circular fibers.

Male genitalia.—Testes 12 to 15, measuring 30 to 35 by 38 to 44 microns, grouped closely together on each side of, and behind, female glands. Vas deferens with several coils, uniform in diameter, extending transversely to near median line and surrounded by prostatic cells. Cirrus sac relatively large, 0.10 to 0.12 by 0.06 to 0.07 millimeter in size; from the genital pore it is directed posteromesially and then bends suddenly in an anterior direction in such a way that the main axis of the organ is parallel with the proglottis margin. A distinct seminal vesicle is not discernible within the cirrus sac; cirrus unarmed.

Female genitalia.—Ovary median, very small, 0.08 millimeter across, consisting of a few follicles arranged fanwise. Vitelline gland with indented margins 0.04 to 0.08 millimeter across,

small in mature segments, attaining its maximum size in young gravid segments. Shell gland as large as vitelline gland, between latter and ovary. Vagina opens posteriorly to cirrus, its proximal end slightly swollen into a seminal receptacle. Uterus appears early in the form of tubules radiating from a center dorsal to the ovary (Plate 3, fig. 3). Egg capsules extend laterally beyond longitudinal excretory vessels, and each contains a single egg. Eggs 57 to 71 by 31 to 38.5 microns, onchospheres 17 to 19 by 15 microns.

Specific diagnosis.—*Raillietina* (*Paroniella*): Length 20 millimeters, maximum width 0.8 millimeter. Rostellar hooks 250, 10.4 to 11.5 microns long. Hooks on suckers 5.8 to 10.4 microns long. Genital pore at middle of proglottis margin; genital sinus roomy. Testes 12 to 15, grouped closely together, almost surrounding female glands. Cirrus sac acutely bent anteriorly, its main axis parallel with proglottis margin. Ovary very small, lobulated. Eggs 57 to 71 by 31 to 38.5, onchospheres 17 to 19 by 15 microns.

Host.—*Lichtensteinipicus funebris.*

Location.—Intestine.

Locality.—Bahi, Sipocot, Camarines Sur, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 330.

RAILLIETINA (PARONIELLA) CORONEA sp. nov. Plate 3, fig. 7.

This is a common parasite of the Philippine crow and appears most closely related to *Raillietina corvina* (Fuhrmann, 1905) and *R. reynoldsæ* Meggitt, 1926, which have been reported from crows in India and Ceylon and in Burma, respectively. It differs from them in the extreme anterior position of the genital pore on the proglottis margin, the greater number of testes and the structure of the ovary and vitelline gland in fully mature segments (Table 2).

External anatomy.—Maximum length 250, maximum width 3.3 millimeters in region of young gravid segments. Proglottids much wider than long except most posterior ones, which are squarish and measure 1.35 to 1.65 by 1.75 to 2.00 millimeters. Head 0.45 millimeter across, neck 0.8 millimeter long. Rostellum 0.11 to 0.13 by 0.15 to 0.17 millimeter, carrying about 200 hooks arranged in two rows and measuring 15.3 to 17.3 microns in length, those of the second row being smaller. Suckers 0.10 to 0.12 millimeter in diameter, armed with hooks arranged in five to six rows and measuring 7.7 to 15.5 microns in

length, their size diminishing towards center of suckers. Genital pores unilateral, at anterior fourth or fifth of proglottid margins.

Musculature.—The musculature is moderately well developed. As usual, there is a layer of larger bundles of longitudinal fibers immediately adjoining the medullary parenchyma and smaller bundles as well as isolated fibers interspersed between the larger bundles and beneath the subcuticula where they are especially numerous. The dorsoventral fibers are also prominent, the circular ones less so.

Male genitalia.—Testes 44 to 46 in number, 60 to 75 microns across, arranged in two unequal groups on each side of ovary, 12 to 16 being poral and 30 to 32 aporal. Cirrus sac small, 0.13 to 0.14 by 0.05 to 0.06 millimeter, extending halfway between proglottis margin and longitudinal nerve. Vas deferens uniform in diameter, with numerous but short coils, running almost parallel to and in front of vagina to near median line; it is surrounded by a few prostatic cells. Seminal vesicle moderately developed; cirrus short and unarmed.

Female genitalia.—Ovary median, much lobulated, its component lobules arranged fanwise; in fully mature segments it attains a maximum transverse diameter of 0.9 millimeter. Vitelline gland also lobulated, immediately behind ovary, 0.3 millimeter across in the fully developed stage. Shell gland small, between ovary and vitelline gland. Vagina opens posteriorly to cirrus; one-half of its length, that is, that portion between the genital pore and the ventral excretory vessel is small in diameter and surrounded by prominent cells, while the other half is thin-walled and swollen and probably functions as a seminal receptacle. Uterus breaks up into egg capsules, each containing a single egg and extending laterally beyond principal excretory vessels to subcuticula. Eggs 34.5 to 42.2 by 30.7 to 36.5, onchospheres 17.3 to 19.2 by 15.4 microns.

Specific diagnosis.—*Raillietina* (*Paroniella*): Length 250, maximum width 3.3 millimeters. Rostellum with 250 hooks 15.3 to 17.3 microns long. Hooks on suckers 7.7 to 15.5 microns long. Genital pore on anterior fourth or fifth of proglottis margin. Testes 44 to 46, 12 to 16 poral and 30 to 32 aporal. Ovary and vitelline gland lobulated. Eggs 34.5 to 42.2 by 30.7 to 36.5, onchospheres 17.3 to 19.2 by 15.4 microns.

Host.—*Corone philippina.*

Location.—Intestine.

Locality.—Novaliches, Rizal, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 120.

RAILLIETINA (PARONIELLA) CULIAUANA sp. nov. Plate 3, fig. 6.

According to the available literature, there is only one member of the subgenus *Paroniella* which has been recorded from orioles; namely, *R. compacta* (Clerc, 1906). As described by Ransom (1909), this species differs from the Philippine parasite in its larger number of rostellar hooks, the smaller number and the arrangement of the testes, and the smaller size of the onchospheres. As a matter of fact *R. culiauana* appears more closely related to the *Paroniella* species reported from crows as well as to one other parasite described below (*R. bulbularum* sp. nov.) which was obtained from another passeriform bird. The distinguishing features of these various tapeworms are given in Table 2.

External anatomy.—Maximum length 150, maximum diameter 3.3 millimeters in region of young gravid segments. Proglottids much wider than long, the most posterior ones, which are trapezoidal, measuring 0.75 to 0.85 by 1.70 to 1.95 millimeters. Head about 0.45 millimeter across, neck at least 1 millimeter long. Rostellum 0.10 by 0.17 millimeter in size, with about 300 hooks arranged in two rows and measuring 15.3 to 18 microns in length. Suckers 0.15 to 0.17 millimeter in diameter, with numerous deciduous hooks 9.6 to 13.4 microns long. Genital pores unilateral, at junction of anterior and middle thirds of proglottid margins or slightly behind that level.

Male genitalia.—Testes 30 to 33, oval, 65 to 88 by 60 to 77 microns in size, arranged in two unequal groups on each side of female organs, 9 to 10 poral and 21 to 23 aporal. Vas deferens with numerous coils, uniform in diameter, extending transversely to near median line and surrounded by prostatic cells. Cirrus sac very prominent, 0.13 to 0.16 by 0.08 to 0.09 millimeter, almost reaching ventral longitudinal excretory vessel. A distinct seminal vesicle not apparent; cirrus long and coiled, unarmed.

Female genitalia.—Ovary median, asymmetrically bilobed, 0.20 to 0.24 millimeter across, each lobe distinctly lobulated. Vitelline gland behind and in contact with ovary, transversely oval to elongate, reaching a maximum diameter of 95 microns in young gravid segments. Shell gland between ovarian lobes. Vagina opening posteriorly to cirrus, swollen for the greater

TABLE 2.—*Comparison of closely related species of Raillietina (Paroniella) parasitic in Passeriformes.*

Species.	Size.		Rostellar hooks.		Length of hooks on suckers.	Testes.	
	Length.	Maximum width.	Number.	Length.		Number.	Location.
	mm.	*mm.*		*μ*	*μ*		
R. compacta (Clerc, 1906)	150	1.3	400	15	10	25	
R. corvina (Fuhrmann, 1905)	120	2–3	80	16–18	9	26–34	In two groups, one on each side of ovary.
R. reynoldsæ Meggitt, 1926	250	3	250	11–17		33–39?	7–12 poral, 26–27 aporal.
R. coronea sp. nov.	250	3.2	200	15.3–17.3	7.7–15.5	44–46	12–16 poral, 30–32 aporal.
R. culiauana sp. nov.	150	3.3	300	15.3–18	9.6–13.4	30–33	9–10 poral, 21–23 aporal.
R. bulbularum sp. nov.	70	1.5	130	20–23	11.5–15.3	26–30	8–10 poral, 18–20 aporal.

Species.	Cirrus sac.		Position of genital pore.	Ovary.	Hosts.	Locality.
	Size.	Extent.				
	mm.					
R. compacta (Clerc, 1906)	0.15 long				*Oriolus galbula, O. auratus, Pyromelana franciscana.*	Ural, Abomey.
R. corvina (Fuhrmann, 1905)	0.10×0.04	One third distance between margin and nerve.	Near middle of proglottis margin.	Lobulated, lobules arranged fanwise.	*Corvus macrorhynchus, C. culminatus, etc.*	India, Ceylon, Siam, Aru Islands.
R. reynoldsæ Meggitt, 1926	0.13–0.21 long	Crossing nerve, not reaching excretory vessel.	Anterior third of proglottis margin.	Much lobed	*Corvus splendens insolens.*	Burma.
R. coronea sp. nov.	0.13–0.14×0.05–0.06	Halfway between proglottis margin and nerve.	Anterior fourth or fifth of proglottis margin.	Lobulated, lobules arranged fanwise.	*Corone philippina*	Philippines.
R. culiauana sp. nov.	0.13–0.16×0.08–0.09	Almost reaching excretory vessel.	Anterior third of proglottis margin.	Bilobed, lobulated	*Oriolus acrorhynchus.*	Do.
R. bulbularum sp. nov.	0.13–0.15×0.06–0.07	Reaching nerve	do	do	*Pycnonotus goiavier*	Do.

part of its length into a seminal receptacle. Egg capsules containing each a single egg and extending laterally beyond longitudinal excretory vessels to near subcuticula. Eggs measure 38.5 to 46 by 34.5 to 38.5, onchospheres 21 to 23 by 19.2 microns.

Specific diagnosis.—*Raillietina* (*Paroniella*): Length 150, maximum width 3.3 millimeters. Rostellum with 300 hooks, 15.3 to 18 microns long. Hooks on suckers 9.6 to 13.4 microns long. Testes 30 to 33, on each side of female glands, 9 to 10 poral, 21 to 23 aporal. Ovary asymmetrically bilobed and lobulated. Eggs 38.5 to 46 by 34.5 to 38.5, onchospheres 21 to 23 by 19.2 microns.

Host.—*Oriolus acrorhynchus.*

Location.—Intestine.

Locality.—Palo, Leyte.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 155.

RAILLIETINA (PARONIELLA) BULBULARUM sp. nov. Plate 3, figs. 4 and 5.

As shown in Table 2, this species is quite similar to *Raillietina culiauana*, from which it differs in the number and size of the rostellar hooks and the extent of the cirrus sac in relation to the ventral longitudinal excretory vessel.

External anatomy.—Maximum length 70, maximum width 1.5 millimeters in region of gravid segments. Proglottids wider than long, the most posterior ones the longest, measuring 0.65 to 0.75 by 1.35 to 1.50 millimeters. Head 0.5 millimeter across, neck at least 1 millimeter long. Rostellum 0.07 to 0.08 by 0.15 to 0.17 millimeter, with 120 to 130 hooks arranged in two rows and measuring 20 to 23 microns in length. Suckers 0.11 to 0.13 by 0.09 to 0.11 millimeter in size, armed with numerous hooks 11.5 to 15.3 microns long and arranged in 7 to 8 rows. Genital pores unilateral, at junction of anterior and middle thirds of lateral margins of proglottids.

Male genitalia.—Testes 26 to 30 in number, 42 to 62 microns in diameter, arranged in two unequal groups on each side of female glands, 8 to 10 being poral and 18 to 20 aporal. Vas deferens very much coiled, uniform in diameter, reaching median line, and surrounded by few prostatic cells. Cirrus sac 0.13 to 0.15 by 0.06 to 0.07 millimeter, just reaching longitudinal nerve; incloses elongate seminal vesicle and unarmed cirrus.

Female genitalia.—Ovary median, 0.15 to 0.20 millimeter across, consisting of two lobulated wings. Vitelline gland behind ovary, 0.07 to 0.13 millimeter across, attaining its maximum size in young gravid segments. Shell gland small, between

wings of ovary. Vagina opens immediately behind cirrus; approximately one-half of its length, or that portion internal to ventral longitudinal excretory vessel, is thin-walled and slightly swollen and probably functions as a seminal receptacle, while the other half is thick-walled and surrounded by prominent cells. Egg capsules, each containing a single egg, extend laterally beyond longitudinal excretory vessels to near subcuticula. No mature eggs were seen.

Specific diagnosis.—*Raillietina* (*Paroniella*): Length 70, maximum width 1.5 millimeters. Rostellum with 120 to 130 hooks, 20 to 23 microns long. Hooks on suckers 11.5 to 15.3 microns long. Testes 26 to 30, on each side of female glands, 8 to 10 poral, 18 to 20 aporal. Ovary bilobed and lobulated.

Host.—*Pycnonotus goiavier.*

Location.—Intestine.

Locality.—Novaliches, Rizal, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 144.

Genus COTUGNIA Diamare, 1893

COTUGNIA ILOCANA sp. nov. Plate 4, figs. 1 and 2.

This species most closely resembles *Cotugnia meggitti* Yamaguti, 1935 (= *C. cuneata* var. *nervosa* Meggitt, 1924). It may be distinguished from the latter by its smaller rostellar hooks, the more numerous testes, the extent of the cirrus pouch, and the size of the eggs and onchospheres.

External anatomy.—Greatest length 60, maximum width 3.9 millimeters in region of gravid segments. All proglottids broader than long. Head 0.70 to 0.76 millimeter across, neck 0.4 millimeter long. Rostellum 0.18 to 0.21 by 0.30 to 0.32 millimeter, armed with about 320 hooks arranged in two rows and measuring 11.5 to 15.3 microns in length, the hooks of the second row being smaller. Suckers 0.16 to 0.20 millimeter in diameter, unarmed. Genital pores bilateral, at about middle of lateral margins of proglottids.

Musculature.—The muscular system is well developed, the longitudinal muscles arranged in three layers, each layer limited internally by a few strands of transverse fibers. Inner layer represented by about twenty-five large bundles on each surface (total fifty) of a segment, each bundle containing about fifty fibers. In the middle layer the bundles are more numerous but smaller, containing only a maximum of ten fibers each. Outer

layer very near the subcuticula and composed of isolated fibers and small bundles of two to five fibers each. There are also a few dorsoventral muscle fibers.

Male genitalia.—Testes 80 to 100 in number, 57 to 77 microns in diameter, grouped together usually in the form of a continuous band in the posterior half of the segment behind the ovaries and extending laterally beyond the ventral longitudinal excretory vessels; the band is 2 to 4 testes deep anteroposteriorly. In well-expanded segments the testes may be divided into two lateral groups on each side of median line. Vas deferens with few fine coils, uniform in diameter, extending to in front of corresponding ovary, surrounded by small prostatic cells. Vas deferens and vagina passing dorsally to ventral longitudinal excretory vessel. Cirrus sac small, 0.19 to 0.22 by 0.05 to 0.06 millimeter, extending to one half or two thirds the distance between margin of segment and excretory vessel. Cirrus unarmed.

Female genitalia.—Ovary bilobed, 0.15 to 0.26 millimeter across, lying closely against corresponding ventral excretory vessel; each lobe composed of a few follicles. Vitelline gland follicular, 0.05 to 0.07 millimeter across, behind ovary. Shell gland small, between ovary and vitelline gland. Vagina short, opening posteriorly to cirrus, its proximal end dilated into a small seminal receptacle. Egg capsules, each containing a single egg, extending laterally beyond excretory vessels and lying very close to subcuticula. Eggs 50 to 60 by 42 to 50 microns, onchospheres 27 to 30 microns in diameter.

Specific diagnosis.—*Cotugnia*: Length 60, maximum breadth 3.9 millimeters. Rostellum with 320 hooks, 11.5 to 15.3 microns long. Testes 80 to 100, usually in one continuous band in posterior half of segment, rarely in two lateral groups. Ovary small, lobulated. Receptaculum seminis present. Eggs 50 to 60 by 42 to 50 microns, onchospheres 27 to 30 microns in diameter.

Host.—*Streptopelia dussumieri.*

Location.—Intestine.

Locality.—Sitio Lumaba, Villaviciosa, Abra, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 512.

COTUGNIA RIMANDOI sp. nov. Plate 4, fig. 3.

This tapeworm is related to *Cotugnia digonophora* (Pasquale, 1890), *C. crdssa* Fuhrmann, 1909, *C. pluriuncinata* Baer, 1925, *C. noctua* Johri, 1934, and *C. taiwanensis* Yamaguti, 1935, in

possessing a large number of testes. It differs from these various species in the large size of the rostellar hooks.

External anatomy.—Greatest length 70, maximum breadth 3.8 millimeters in region of gravid segments. All proglottids wider than long. Head 0.50 to 0.57 millimeter across; neck very short. Rostellum 0.25 by 0.23 millimeter, armed with about 300 hooks 20 to 23 microns long and arranged in two alternating rows. Suckers 0.14 to 0.17 millimeter in diameter, unarmed. Genital pores bilateral, in front of middle of lateral margins of proglottids.

Musculature.—The muscular system is poorly developed. Only two layers of longitudinal muscles are present—an inner layer consisting of a single row of small bundles of fibers and a thick outer layer of single fibers that extend to near the subcuticle. Dorsoventral and transverse fibers are few and weak.

Male genitalia.—Testes 100 to 136 in number, 40 to 42 microns in diameter, in one continuous band in posterior half of segment and extending laterally beyond excretory vessels; the band is 3 to 6 testes deep anteroposteriorly. Vas deferens with few short coils, uniform in diameter, extending to in front of corresponding ovary and surrounded by small prostatic cells. Cirrus sac 0.17 to 0.28 by 0.05 to 0.06 millimeter, just reaching to excretory vessel. Cirrus not coiled, unarmed.

Female genitalia.—Ovary crescentic, 0.19 to 0.30 millimeter across, composed of lobules arranged fanwise; it is separated by a clear space from corresponding ventral excretory vessel. Vitelline gland large, 0.08 to 0.13 millimeter across, behind ovary. Shell gland small, between ovary and vitelline gland. Vagina short, opening posteriorly behind cirrus; just before reaching shell gland it is slightly dilated to form a small receptaculum seminis. Egg capsules, containing a single egg each, extending laterally beyond excretory vessels. Eggs 73.0 to 84.5 by 57.6 to 69.0 microns, onchospheres 29.0 to 30.7 microns in diameter.

Specific diagnosis.—*Cotugnia*: Length 70, maximum width 3.8 millimeters. Rostellum with 300 hooks, 20 to 23 microns long, arranged in two rows. Testes 100 to 136, in a single band 3 to 6 testes deep anteroposteriorly. Cirrus sac 0.17 to 0.28 by 0.05 to 0.06 millimeter, just reaching to excretory vessel. Ovary crescentic, lobulated. Receptaculum seminis present. Eggs 73.0 to 84.5 by 57.6 to 69.0 microns, onchospheres 29.0 to 30.7 microns in diameter.

Host.—Domestic pigeon.
Location.—Intestine.
Locality.—Manila, Philippines.
Type specimens.—Philippine Bureau of Science parasitological collection, No. 172.

Family HYMENOLEPIDIDÆ Railliet and Henry, 1909

Genus HYMENOLEPIS Weinland, 1858

HYMENOLEPIS CORONOIDIS sp. nov. Plate 5, figs. 1, 2, 3, and 4.

This parasite of the Philippine crow resembles *Hymenolepis farciminosa* (Goeze, 1782), as reported by Meggitt (1926) from *Acridotheres tristis* in Rangoon, and by Southwell (1930) from *Corvus macrorhynchus* in Calcutta, in so many details that it is a question as to whether it should be considered as an independent species or only a varietal form. The only constant differences between the two are in the size of the worms, the Philippine form being shorter but wider, and in the shape of the rostellar hooks (Plate 5, figs. 2 and 5). Another feature of *H. coronoidis* which has not been given for *H. farciminosa* even by Rosseter (1908), who described the parasite very minutely, is the presence of threadlike processes arising from each pole of the onchosphere.

External anatomy.—Greatest length 160, maximum width 1.8 millimeters in region of gravid segments. Proglottids wider than long except the most posterior ones which are squarish. Head 0.35 millimeter across, neck 0.4 to 0.6 millimeter long. Rostellum 0.08 by 0.08 millimeter in size, armed with a single row of ten hooks 20 microns long and possessing a blade much shorter than either of the two roots. Rostellar sac extends to level of posterior border of suckers. Suckers 0.10 to 0.12 millimeter in diameter, unarmed. Genital pores unilateral, at middle of proglottis margin or slightly in front of that level.

Male genitalia.—Testes three (rarely four), subglobular to oval, 0.17 to 0.23 by 0.20 to 0.26 millimeter in size, and arranged as follows: one poral and two aporal, of which one is directly in front of, or anterior and slightly external to, the other. In certain cases there is no poral testis, the organs being concentrated on the aporal side of the segment. In proglottids with four testes, one or two are poral and the rest aporal. Cirrus sac 0.24 to 0.27 by 0.050 to 0.065 millimeter, barely extending to, and in some segments slightly beyond, the ventral longitudinal excretory vessel. Internal seminal vesicle small, cirrus short

and unarmed. External seminal vesicle not conspicuous and not crossing median line.

Female genitalia.—Ovary 0.4 to 0.5 millimeter across, bilobed, each lobe almost rounded and smooth in young mature segments; in older segments it assumes an irregular shape. Vitelline gland 0.10 to 0.15 millimeter across, immediately behind ovary. Shell gland small, between ovary and vitelline gland. Vagina opening posteriorly to cirrus and running almost parallel with cirrus pouch, passing with the latter dorsally to longitudinal excretory vessels; it is enlarged in diameter in several places along its course towards the ovary, thus probably serving as receptaculum seminis at the same time. Uterus partly septate, confined between longitudinal excretory vessels. Eggs oval, with two shells; outer shell measures 78.7 to 103.7 by 65.3 to 96 microns; inner shell 36.4 to 41 by 27 to 31.5 microns, thickened at each pole, from which arise numerous threadlike processes that unite into a tangled mass around the onchosphere. Embryonal hooks 18 to 20 microns long.

Specific diagnosis.—*Hymenolepis:* Length 160, maximum width 1.8 millimeters. Rostellum with one row of ten hooks 20 microns long, with blade much shorter than either of two roots; rostellar sac extending posteriorly to posterior border of suckers. Testes three (rarely four), one (rarely two) poral and the rest aporal. One aporal testis directly in front of, or anterior and slightly external to, the other. Cirrus pouch 0.24 to 0.27 by 0.050 to 0.065 millimeter in size, sometimes reaching slightly median to excretory vessel. Ovary at first symmetrically bilobed, later assuming an irregular shape. Outer shell of eggs 78.7 to 103.7 by 65.3 to 96, inner shell 36.4 to 41 by 27 to 31.5 microns. Inner shell with threadlike processes arising from its two polar thickenings.

Host.—*Corone philippina.*

Location.—Intestine.

Locality.—Palo, Leyte.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 162.

HYMENOLEPIS PYCNONOTI sp. nov. Plate 4, figs. 4, 5, and 6.

This species is represented by a single specimen from the intestine of a guava bulbul. It bears some resemblance to *H. coronoidis,* as described above, as well as to *H. farciminosa* (Goeze, 1782) and *H. planestici* Mayhew, 1925. It differs from *H. coronoidis* in the shape of the segments, the rostellar hooks, and ovary, and in the structure of the eggs; from *H. farciminosa*

in the shape of the segments and the ovary, and in the position of the genital pores; and from *H. planestici* in the size of the hooks and the position of the genital pores.

External anatomy.—Length 45, maximum breadth 2 millimeters in region of gravid segments. All proglottids very much wider than long. Head 0.20 by 0.30 millimeter; neck practically absent. Rostellum very small, 0.09 by 0.05 millimeter in size, with a single row of ten hooks 19 microns long, their blades as long as either of the two roots. Suckers 0.10 millimeter across, unarmed. Genital pores unilateral, at anterior third or fourth of lateral margins of segments. A small genital sinus present.

Male genitalia.—Testes three (one poral, two aporal), transversely oval, 0.04 to 0.07 by 0.06 to 0.12 millimeter in size; one aporal testis anterior and slightly external to its fellow. Occasionally only two testes are present, one on each side of ovary. Cirrus sac measures 0.26 to 0.30 by 0.05 to 0.08 millimeter, one fourth to one third of its length reaching mesially beyond longitudinal excretory vessels. External seminal vesicle about as long as cirrus sac, not crossing median line. Internal seminal vesicle prominent; cirrus short, unarmed.

Female genitalia.—Ovary 0.21 to 0.45 millimeter across, lobulated, the lobules arranged fanwise. Vitelline gland also lobulated, behind and in contact with ovary. Shell gland small, dorsal to ovary. Vagina short, opening posteriorly to cirrus; receptaculum seminis small, not reaching mesially as far as external seminal vesicle. Uterus partly septate, limited between longitudinal excretory vessels. Eggs oval, with two shells: outer shell 57.6 to 76.8 by 50 to 54, inner shell 27 to 30.7 by 25 to 27 microns; embryonal hooks 19 microns long.

Specific diagnosis.—*Hymenolepis*: Length 45, maximum width 2 millimeters. Rostellar hooks ten, 19 microns long, the blades and roots about equal in length. One aporal testis usually anterior and slightly external to its fellow. Cirrus sac 0.26 to 0.30 by 0.05 to 0.08 millimeter, one fourth to one third of its length crossing excretory vessels. Ovary and vitelline gland lobulated. Eggs (outer shell) measure 57.6 to 76.8 by 50 to 54, inner shell 27 to 30.7 by 25 to 27 microns; embryonal hooks 19 microns long.

Host.—*Pycnonotus goiavier.*

Location.—Intestine.

Locality.—Sipocot, Camarines Sur, Luzon.

Type specimen.—Philippine Bureau of Science parasitological collection, No. 335.

HYMENOLEPIS sp. Plate 6, figs. 1 and 2.

This is represented by two complete but poorly preserved specimens (No. 514) from the Philippine bulbul, *Iole gularis.* In view of the absence of rostellar hooks in both sets of proglottids, a definite identification has not been attempted.

External anatomy.—Length 50, maximum width 1.2 millimeters in region of gravid segments. Proglottids wider than long, the shape being trapezoidal. Head 0.5 to 0.6 millimeter across; neck very short, practically absent. Rostellum 0.22 by 0.10 millimeter in size, devoid of hooks, which probably were lost. Suckers 0.20 to 0.23 millimeter across, unarmed. Genital pores unilateral, in anterior third of lateral margins of segments or a little behind that level.

Male genitalia.—Testes three, oval to round, 0.07 to 0.09 by 0.06 to 0.09 millimeter, one poral and two aporal; one aporal testis anterior and median to its fellow. Cirrus sac 0.15 to 0.19 by 0.04 to 0.05 millimeter, about one half of its length across ventral excretory vessel. External vesicula seminalis small, rounded.

Female genitalia.—Ovary fan-shaped, lobulated, 0.13 to 0.20 millimeter across. Vitelline gland large and prominent, immediately behind ovary. Vagina opening posteriorly to cirrus; in the region of the ovary it forms a small receptaculum seminis. Uterus saclike, partly septate, not extending laterally beyond longitudinal excretory vessels. Eggs with two shells; outer shell 46.0 to 57.6 by 42.2 to 50.0 microns, inner shell 27.0 to 34.5 by 30.7 microns. Embryo 23 to 26 microns across; embryonal hooks 15 to 17 microns long.

Host.—*Iole gularis.*

Location.—Intestine.

Locality.—Novaliches, Rizal, Luzon.

Genus FUHRMANNIELLA Tseng, 1933

FUHRMANNIELLA CLERCI Tseng, 1933. Plate 5, figs. 6, 7, and 8.

Our specimens of this parasite (No. 296) were obtained from the same type of host as those studied by Tseng (1933). They tally well with Tseng's description except that the rostellar hooks are bigger, being 32.5 to 34.5 microns long. In Tseng's specimens they are 27 to 28.8 microns long.

Host.—*Rostratula capensis.*

Location.—Intestine.

Locality.—Novaliches, Rizal, Luzon.

Genus DIORCHIS Clerc, 1903

DIORCHIS VISAYANA sp. nov. Plate 7, figs. 1, 2, and 3.

Compared with the members of the genus *Diorchis* described and listed by Mayhew, 1929, and *D. nyrocæ* Yamaguti, 1935, this parasite most closely resembles *D. acuminata* (Clerc, 1902), but differs from it in its fewer but larger rostellar hooks, longer cirrus sac, and shape of ovary.

External anatomy.—Greatest length 120 millimeters, maximum width 1.0 millimeter in region of gravid segments. All proglottids wider than long. Head 0.32 millimeter across, neck 0.3 millimeter long. Rostellum 0.16 to 0.18 by 0.08 to 0.09 millimeter, carrying near its tip one row of eight hooks 48 to 50 microns long. Rostellar sac reaches well behind posterior level of suckers. Suckers 0.12 to 0.14 by 0.10 millimeter, unarmed. Genital pores unilateral, at middle of lateral margins of proglottids.

Musculature.—As in other species of *Diorchis,* there are two conspicuous layers of longitudinal muscles, an outer layer composed of numerous small bundles of fibers and an inner layer of eight larger bundles. The other muscle fibers are poorly developed.

Male genitalia.—Testes two, side by side, behind and dorsal to ovary, 0.042 to 0.058 by 0.075 to 0.094 millimeter. Vas deferens short, swollen for the most part into a roundish external seminal vesicle. Cirrus sac elongate, 0.28 to 0.40 by 0.027 to 0.038 millimeter, reaching slightly beyond median line, the greater part of its length occupied by internal seminal vesicle. Cirrus slender, unarmed, 0.080 to 0.096 millimeter long, with a globular swelling at its base 19 to 23 microns in diameter.

Female genitalia.—Ovary median, subglobular to oval, 0.05 to 0.07 by 0.06 to 0.09 millimeter. Vitelline gland prominent, behind and overlapping ovary. Shell gland small, dorsal to ovary. Vagina opens posteriorly to cirrus; after crossing ventral excretory vessel it becomes enormously swollen into a large receptaculum seminis. Uterus a simple sac, nonseptate, extends laterally beyond longitudinal excretory vessels. Eggs elongate, outer shell measuring 57.6 to 73 by 23 to 29, and the inner shell 38.4 to 42.2 by 15.4 to 19.2 microns.

Specific diagnosis.—*Diorchis:* Length 120, maximum breadth 1.0 millimeter. Rostellar hooks eight, 48 to 50 microns long. Cirrus sac crosses median line. Cirrus unarmed, 80 to 96

microns long, with a bulbous swelling at base 19 to 23 microns in diameter. Ovary smooth, subglobular to oval. Outer shell of egg measures 57.6 to 73 by 23 to 29, inner shell 38.4 to 42.2 by 15.4 to 19.2 microns.

Host.—*Gallinula chloropus.*

Location.—Intestine.

Locality.—Palo, Leyte.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 149.

Genus HAPLOPARAXIS Clerc, 1903

HAPLOPARAXIS SANJUANENSIS sp. nov. Plate 4, figs. 7, 8, and 9.

This parasite may be distinguished from the members of the genus *Haploparaxis* listed by Tseng (1933) and by Yamaguti (1935) by the size of its rostellar hooks, which are intermediate between those of *H. diminuens* v. Linstow and *H. clerci* Yamaguti; the length of its cirrus pouch, which extends to or just beyond the excretory vessel; and the size of the eggs.

External anatomy.—Greatest length 100, maximum width 1.1 millimeters in region of gravid segments. All proglottids wider than long. Head 0.25 millimeter across, neck 0.4 to 0.6 millimeter long. Rostellum 0.08 to 0.09 by 0.03 to 0.04 millimeter, armed at its tip with a single row of ten hooks 16.5 to 17.5 microns long. Rostellar sac 0.2 millimeter long, extending posteriorly to behind level of suckers. Suckers 0.10 to 0.12 millimeter across, unarmed. Genital pores unilateral, usually behind middle of lateral margins of segments.

Male genitalia.—Testis single, behind and dorsal to ovary, median, slightly oval, 0.07 to 0.09 by 0.08 to 0.12 millimeter. External seminal vesicle pyriform, not crossing median line. Cirrus sac elongate, 0.19 to 0.22 by 0.023 to 0.027 millimeter, extending to or just crossing ventral longitudinal excretory vessel. Internal seminal vesicle occupying one half of length of cirrus sac. Cirrus short, unarmed, slightly swollen at its tip.

Female genitalia.—Ovary in front of middle and slightly towards poral side of segment, transversely elongate, 0.14 to 0.17 millimeter across, with a slight constriction at middle. Vitelline gland behind and in contact with ovary, 0.04 to 0.05 by 0.03 to 0.04 millimeter, also towards poral side of segment. Shell gland small, between ovary and testis. Vagina opening posteroventrally to cirrus; before reaching excretory vessel, it becomes

swollen into a roundish or oval receptaculum seminis which does not extend mesially as far as external seminal vesicle. Receptaculum seminis as well as male genital canals passes dorsally to longitudinal excretory vessels. Uterus partly septate, extends laterally beyond excretory vessels. Eggs with three shells: outer shell variable in shape and size; middle shell lemon-shaped and plugged at each pole, 46 to 57.6 by 38.5 to 50 microns; inner shell rounded, 38.5 to 40 microns across. Embryo 28.8 to 30 microns in diameter; embryonal hooks 16 to 19 microns long.

Specific diagnosis.—Haploparaxis: Length 100, maximum width 1.1 millimeters. Rostellar hooks ten, 16.5 to 17.5 microns long. Cirrus sac 0.19 to 0.22 by 0.023 to 0.027 millimeter, extending to or just passing excretory vessel. Ovary transversely elongate, constricted at middle. Eggs with three shells: outer shell variable in shape and size; middle shell lemon-shaped, plugged at both ends, 46 to 57.6 by 38.5 to 50 microns, inner shell round, 38.5 to 40 microns across; embryo 28.8 to 30 microns across, embryonal hooks 16 to 19 microns long.

Host.—Gallinago megala.

Location.—Intestine.

Locality.—San Juan, Rizal, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 121.

Family DILEPIDIDÆ Fuhrmann, 1907

Genus KOWALEWSKIELLA Baczyñska, 1914

KOWALEWSKIELLA BUZZARDIA sp. nov. Plate 6, figs. 3, 4, 5, and 6.

The material available for description consists of a single set of proglottids obtained from a tic-wee buzzard. The anatomical features of the parasite agree with the definition of the genus *Kowalewskiella,* as given by Meggitt (1924), but we have been unable to make any comparison with the type species of the genus due to the inaccessibility of Baczyñska's paper.

External anatomy.—Length 160, maximum width 1.9 millimeters in region of young gravid segments. Proglottids trapezoidal, wider than long, the longest posterior segments measuring 0.60 to 0.70 by 1.40 to 1.90 millimeters. Head 0.47 by 0.40 millimeter, neck about 2.5 millimeters long. Rostellum 0.10 by 0.13 millimeter in size, armed with a single crown of ten hooks possessing well-developed blades and long dorsal and short ventral roots and measuring 61 to 65 microns in length. Suckers

weak, 0.12 millimeter across. Genital pores irregularly alternate, at junction of anterior and middle thirds of lateral margins of segments or slightly in front of that level.

Male genitalia.—Testes disclike, 65 to 70 microns across, 20 behind, and 10 in front of left lobe of, ovary (total 30). Vas deferens extensively coiled, uniform in diameter, surrounded by prostatic cells and reaching beyond median line. Cirrus sac well developed, 0.40 by 0.10 millimeter, more than one half of its length lying internally to ventral longitudinal excretory vessel. Cirrus sac and vagina pass between dorsal and ventral longitudinal excretory vessels. A distinct vesicula seminalis is absent; cirrus long, coiled, and armed with spines.

Female genitalia.—Ovary large, bilobed, with indented margins, 0.75 to 0.95 millimeter across and extending from one ventral longitudinal excretory vessel to the other. Vitelline gland 0.20 to 0.28 millimeter across, behind and in contact with ovary. Vagina opens posteriorly to cirrus, its proximal portion enlarged into a receptaculum seminis. Uterus a transverse sac, lobed, confined between ventral longitudinal excretory vessels. No mature eggs seen.

Host.—*Butastur indicus.*

Location.—Intestine.

Locality.—Palo, Leyte.

Type specimen.—Philippine Bureau of Science parasitological collection, No. 164.

Family ACOLEIDÆ Ransom, 1909

Genus GYROCŒLIA Fuhrmann, 1899

GYROCŒLIA PARADOXA (Linstow, 1906). Plate 7, figs. 4, 5, 6, and 7.

In spite of certain morphological features that do not tally with the description of von Linstow (1906), we have referred to this species a single poorly preserved specimen (No. 165) obtained from the lesser sand plover, *Ochthodromus mongolus*, the type host of the parasite.

External anatomy.—Length only 35 millimeters, due no doubt to absence of gravid segments; maximum width 1.9 millimeters near posterior end. All segments wider than long. Head 0.5 millimeter across. Neck very short. Rostellum 0.23 by 0.11 millimeter in size, armed with about 100 hooks 25 microns long and arranged in a zigzag row possessing eight angles. Suckers 0.19 millimeter across, unarmed. Male genital openings irregularly alternate, in front of middle of proglottid margins.

Male genitalia.—Testes lacking. The absence of these organs in certain individuals of this species was observed by Clausen (1915), according to Tseng (1933), and by Tseng in the case of *Gyrocœlia fausti.* Cirrus pouch very large, bottle-shaped, 0.66 to 0.78 by 0.23 to 0.25 millimeter. Cirrus also well developed, armed with numerous, strong backward-pointing spines.

Female genitalia.—Ovary bilobed, 0.25 to 0.30 millimeter across. Vitelline gland 0.13 to 0.22 millimeter across, immediately behind ovary. Shell gland small, roundish, 0.03 millimeter across. Uterus appears early, first as a simple tubular ring, later with numerous outpocketings. Area surrounded by uterus filled with spongy tissue in some segments.

Host.—*Ochthodromus mongolus.*

Location.—Intestine.

Locality.—Palo, Leyte.

SUMMARY

In the study of a collection of cestodes of Philippine birds, nineteen different species have been identified, of which the following fifteen species are described as new: *Raillietina* (*Raillietina*) *daetensis, R.* (*R.*) *sequens, R.* (*R.*) *torquata* (Meggitt, 1924) var. *rajæ, R.* (*Paroniella*) *tinguiana, R.* (*P.*) *cirroflexa, R.* (*P.*) *coronea, R.* (*P.*) *culiauana, R.* (*P.*) *bulbularum, Cotugnia ilocana, C. rimandoi, Hymenolepis coronoidis, H. pycnonoti, Diorchis visayana, Haploparaxis sanjuanensis,* and *Kowalewskiella buzzardia.*

The following are reported for the first time from the Philippines: *Aporina delafondi* (Railliet, 1892), *Fuhrmanniella clerci* Tseng, 1933, and *Gyrocœlia paradoxa* (Linstow, 1906).

A species of *Hymenolepis* lacking rostellar hooks is described from a bulbul, *Iole gularis.*

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ILLUSTRATIONS

PLATE 1

FIG. 1. *Aporina delafondi* (Railliet, 1892) Baer, 1927, head.
2. *Aporina delafondi* (Railliet, 1892) Baer, 1927, mature segments.
3. *Aporina delafondi* (Railliet, 1892) Baer, 1927, gravid segment.
4. *Raillietina* (*Raillietina*) *daetensis* sp. nov., head.
5. *Raillietina* (*Raillietina*) *daetensis* sp. nov., *a*, rostellar hook; *b*, hook from sucker.
6. *Raillietina* (*Raillietina*) *daetensis* sp. nov., mature segments.

PLATE 2

FIG. 1. *Raillietina* (*Raillietina*) *sequens* sp. nov., mature segments.
2. *Raillietina* (*Raillietina*) *torquata* (Meggitt, 1924) var. *rajæ* var. nov., mature segments.
3. *Raillietina* (*Paroniella*) *tinguiana* sp. nov., head.
4. *Raillietina* (*Paroniella*) *tinguiana* sp. nov., mature segment.
5. *Raillietina* (*Paroniella*) *tinguiana* sp. nov., segment showing developing uterus.

PLATE 3

FIG. 1. *Raillietina* (*Paroniella*) *cirroflexa* sp. nov., head.
2. *Raillietina* (*Paroniella*) *cirroflexa* sp. nov., mature segments.
3. *Raillietina* (*Paroniella*) *cirroflexa* sp. nov., segment showing developing uterus.
4. *Raillietina* (*Paroniella*) *bulbularum* sp. nov., head.
5. *Raillietina* (*Paroniella*) *bulbularum* sp. nov., mature segments.
6. *Raillietina* (*Paroniella*) *culiauana* sp. nov., mature segments.
7. *Raillietina* (*Paroniella*) *coronea* sp. nov., mature segments.

PLATE 4

FIG. 1. *Cotugnia ilocana* sp. nov., head.
2. *Cotugnia ilocana* sp. nov., mature segment.
3. *Cotugnia rimandoi* sp. nov., mature segment.
4. *Hymenolepis pycnonoti* sp. nov., head.
5. *Hymenolepis pycnonoti* sp. nov., rostellar hook.
6. *Hymenolepis pycnonoti* sp. nov., mature segments.
7. *Haploparaxis sanjuanensis* sp. nov., head.
8. *Haploparaxis sanjuanensis* sp. nov., rostellar hooks.
9. *Haploparaxis sanjuanensis* sp. nov., mature segments.

PLATE 5

FIG. 1. *Hymenolepis coronoidis* sp. nov., head.
2. *Hymenolepis coronoidis* sp. nov., rostellar hooks.
3. *Hymenolepis coronoidis* sp. nov., mature segments.

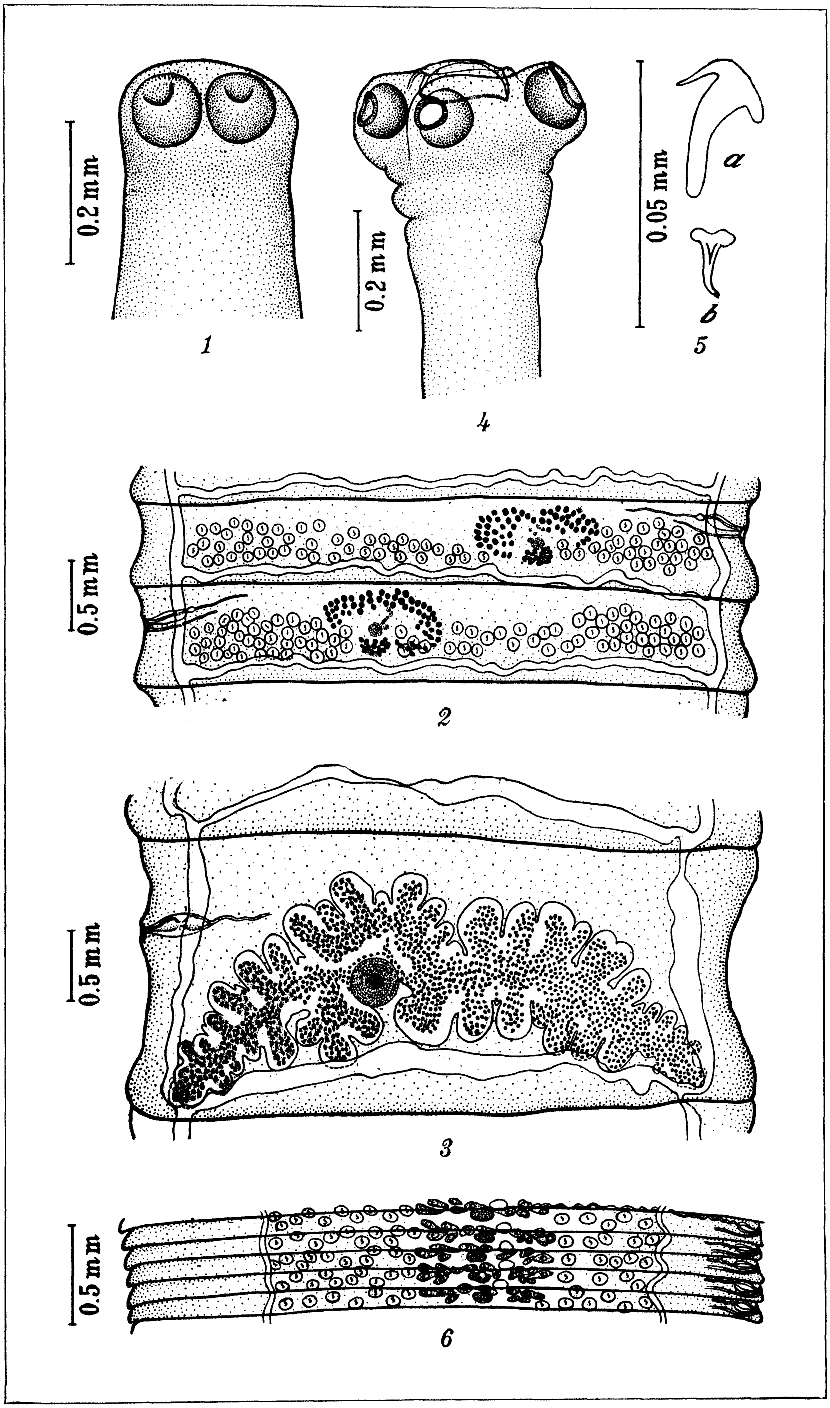
FIG. 4. *Hymenolepis coronoidis* sp. nov., egg.
5. *Hymenolepis farciminosa* (Goeze, 1782), rostellar hooks. (From Meggitt, 1926.)
6. *Fuhrmanniella clerci* Tseng, 1933, head.
7. *Fuhrmanniella clerci* Tseng, 1933, rostellar hook.
8. *Fuhrmanniella clerci* Tseng, 1933, mature segments.

PLATE 6

FIG. 1. *Hymenolepis* sp., head.
2. *Hymenolepis* sp., mature segments.
3. *Kowalewskiella buzzardia* sp. nov., head.
4. *Kowalewskiella buzzardia* sp. nov., rostellar hook.
5. *Kowalewskiella buzzardia* sp. nov., mature segment.
6. *Kowalewskiella buzzardia* sp. nov., gravid segment.

PLATE 7

FIG. 1. *Diorchis visayana* sp. nov., head.
2. *Diorchis visayana* sp. nov., rostellar hook.
3. *Diorchis visayana* sp. nov., mature segments.
4. *Gyrocœlia paradoxa* (Linstow, 1906), rostellum.
5. *Gyrocœlia paradoxa* (Linstow, 1906), rostellar hook.
6. *Gyrocœlia paradoxa* (Linstow, 1906), mature segment showing female genitalia and cirrus pouch.
7. *Gyrocœlia paradoxa* (Linstow, 1906), segment showing developing uterus.



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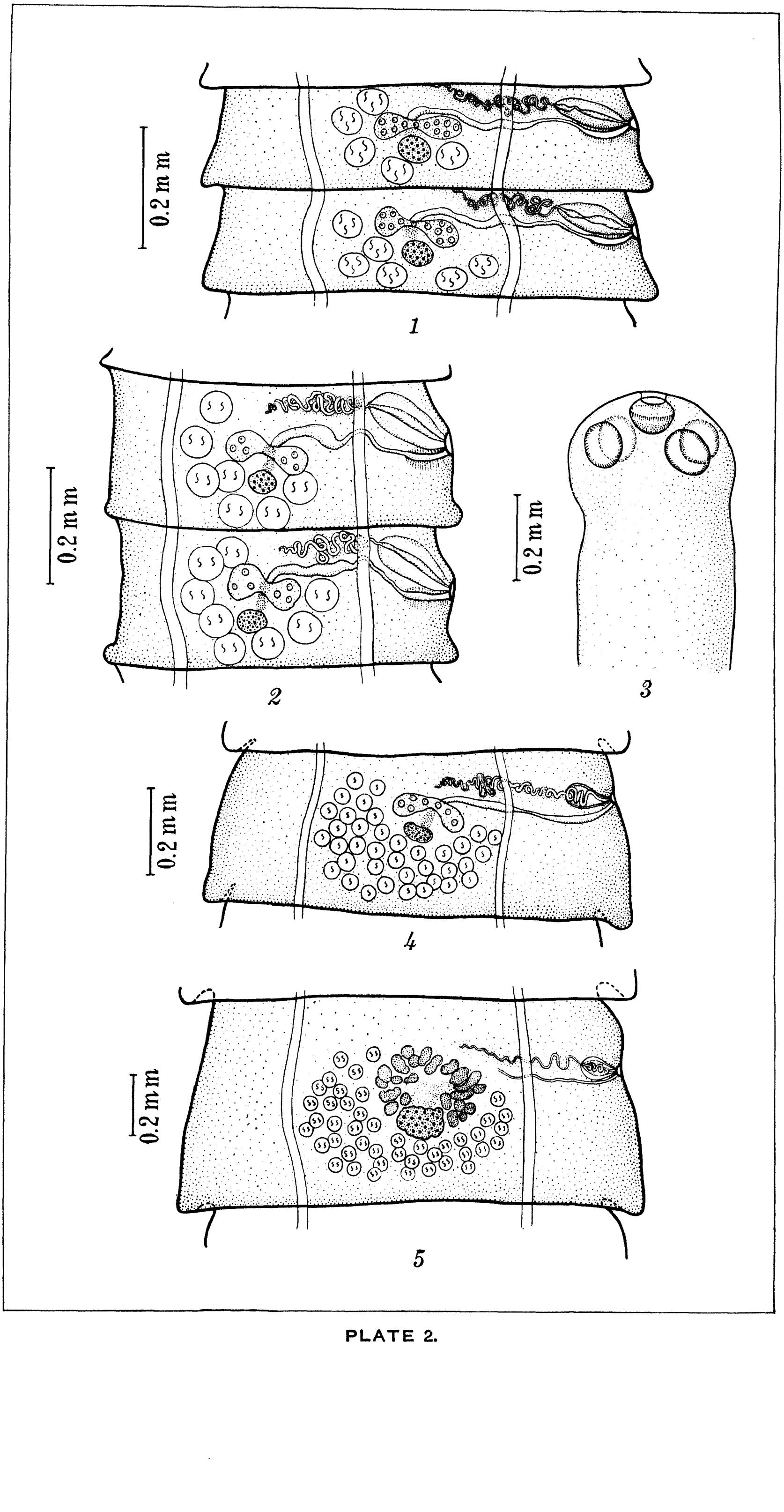

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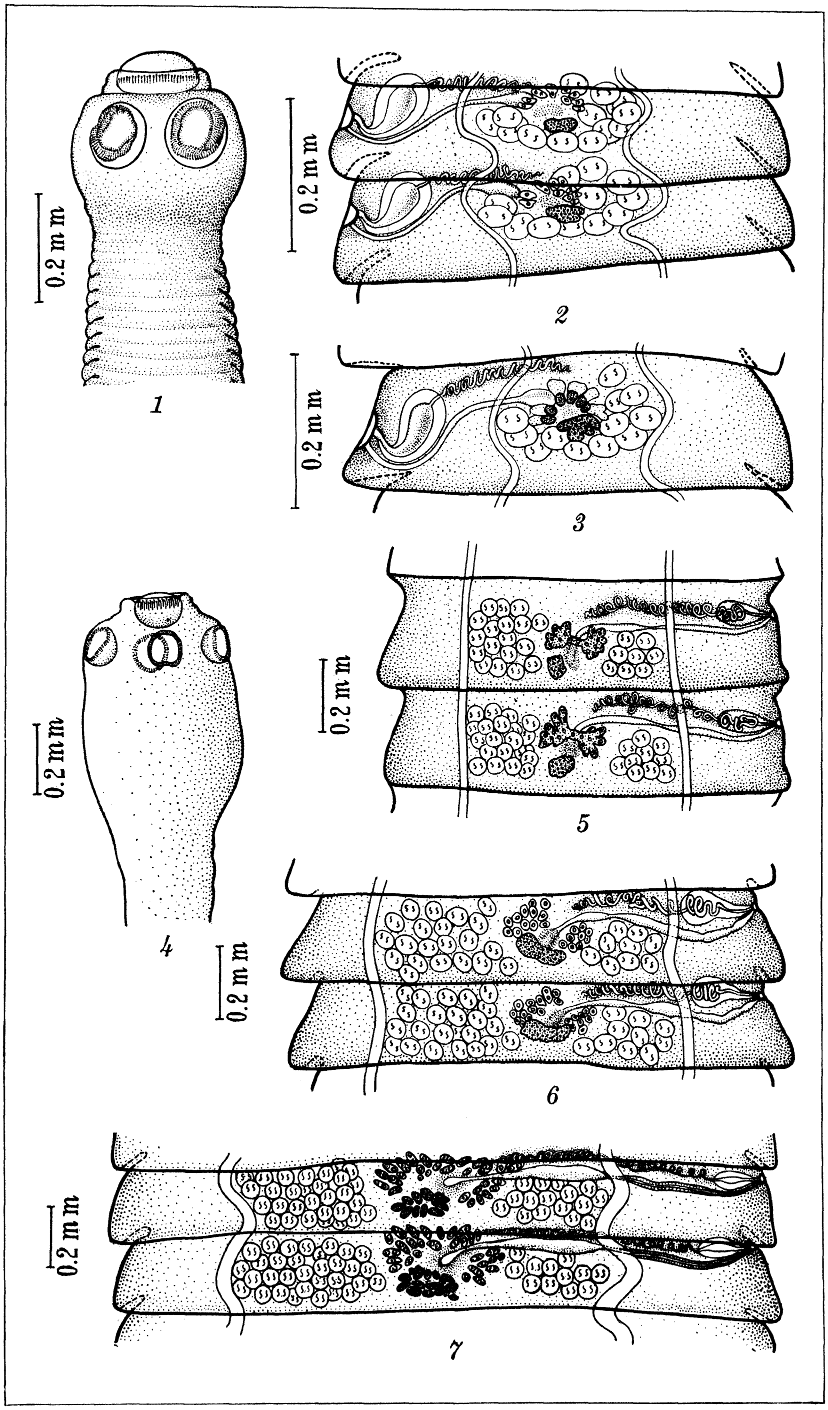

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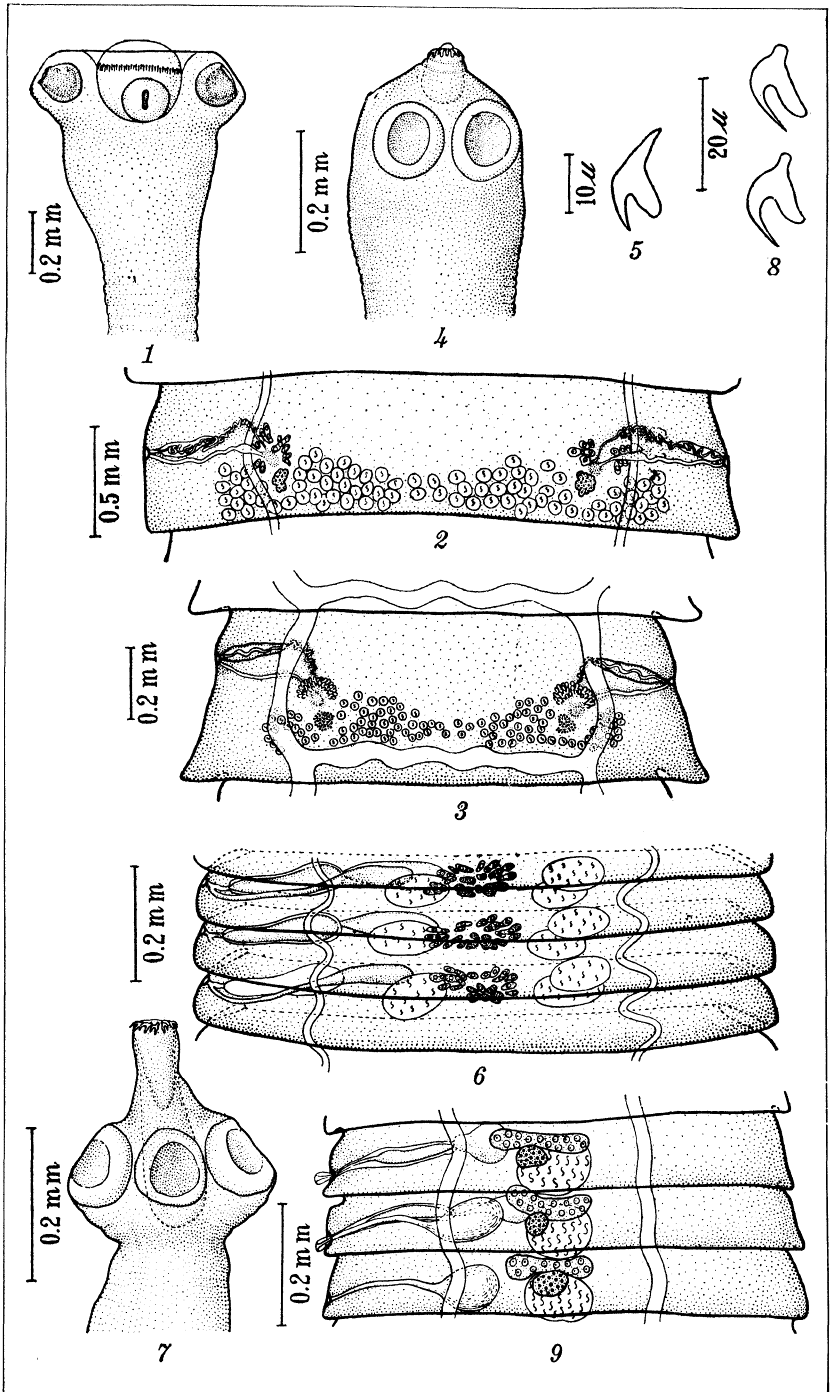

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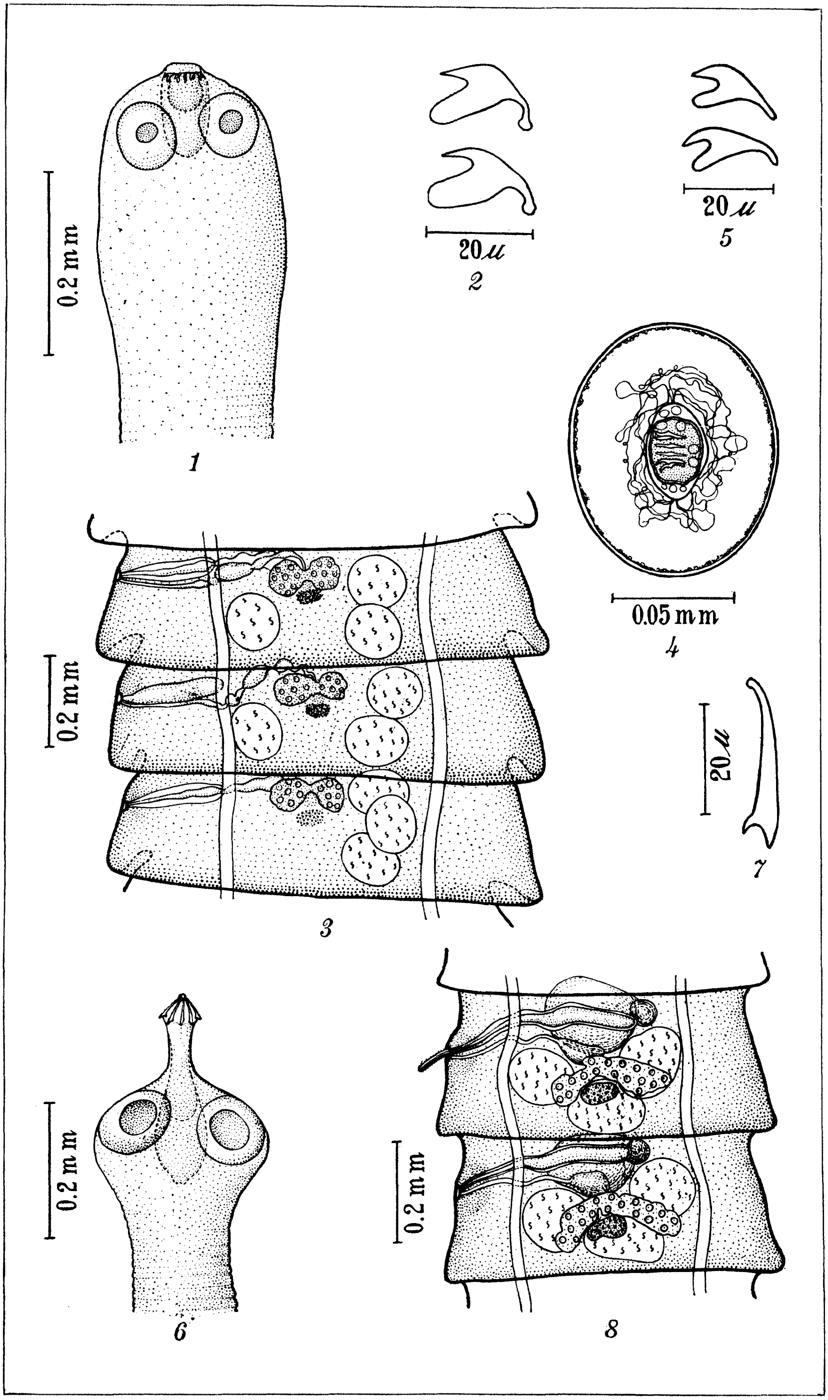

PLATE 5.

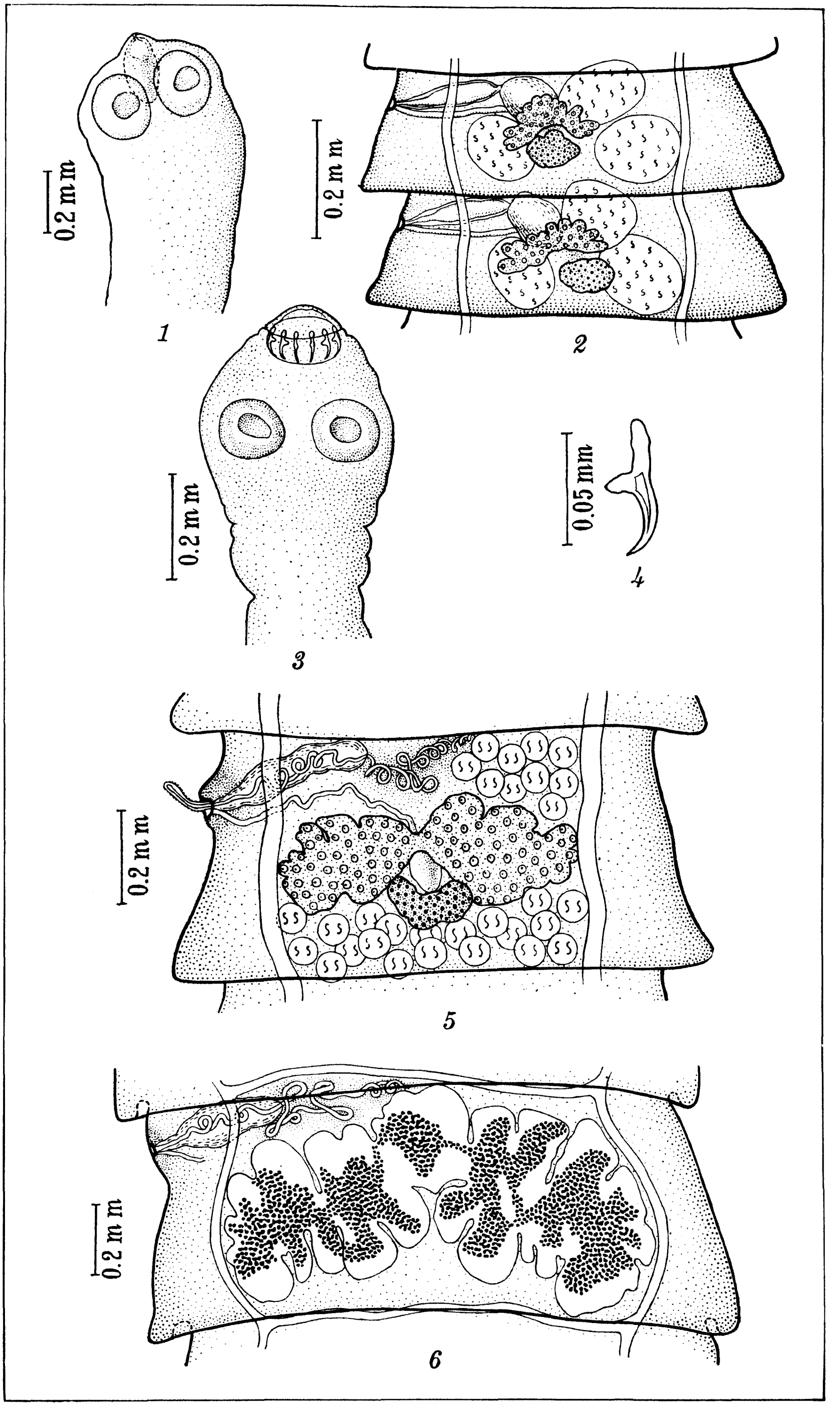

PLATE 6.

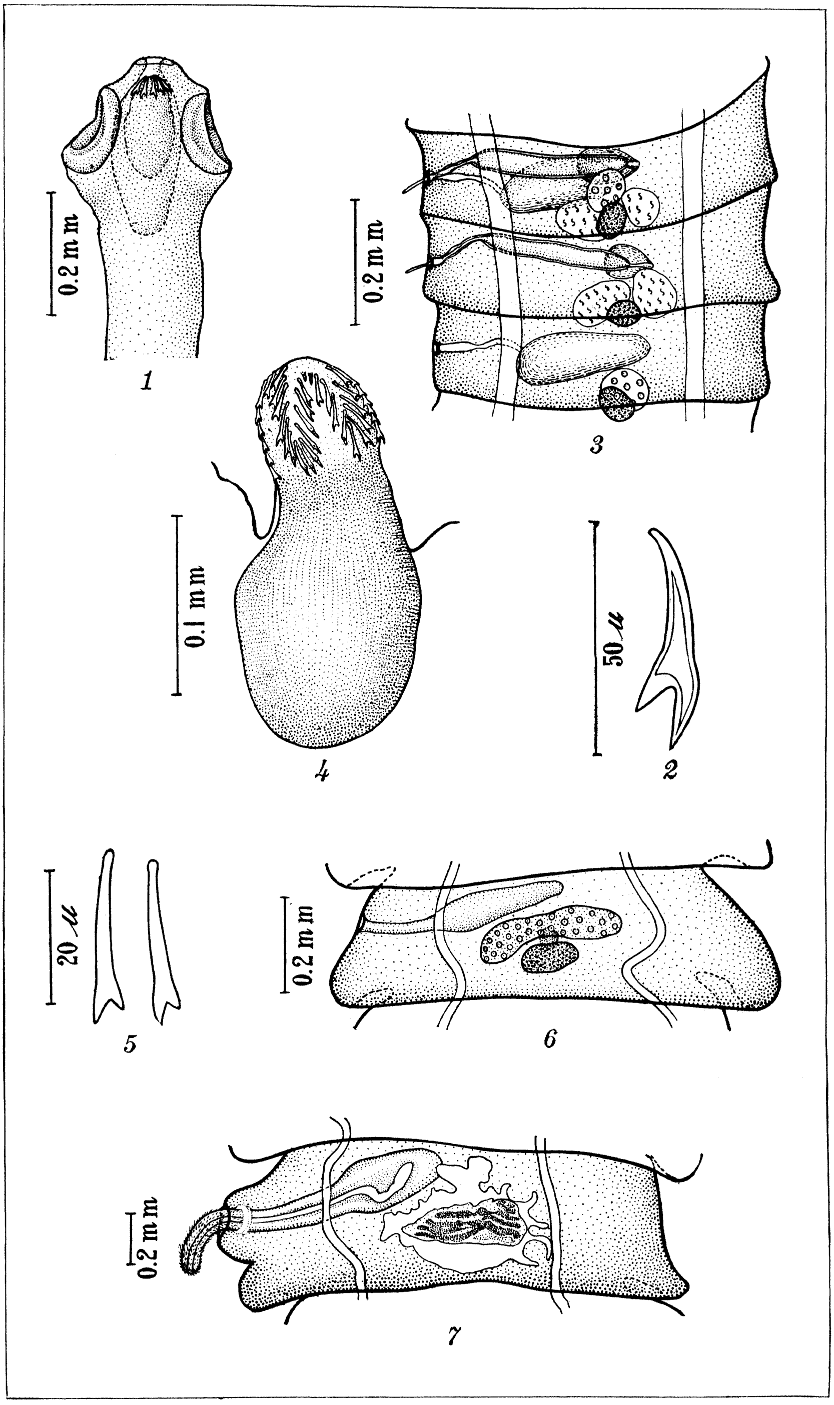

PLATE 7.

VARIATIONS IN THE ACTINOMYCETES, IN CONNECTION WITH THE THEORY OF THE MYCOTIC NATURE OF THE VIRUSES OF TUBERCULOSIS AND LEPROSY.[1]

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TWO PLATES

I

Many years ago, when studying the causative organism of leprosy, I advanced two essential conceptions: (*a*) Acid-fastness is an unstable condition which can vary within wide limits up to complete disappearance; thus, the leprosy bacillus (and by analogy also that of tuberculosis) can exist in both acid-fast and acid-sensitive forms. (*b*) The causative germ of leprosy can change in an artificial medium (or, of the same effect, when in the outside world) into a more highly differentiated microbe, a mycotic form of the type of *Actinomyces* or *Streptothrix*.

With regard to the possibility that the Hansen bacillus can exist in a non-acid-fast form, I succeeded in transforming by animal passage non-acid-fast diphtheroids isolated from leprous material into acid-fast rods that were morphologically similar to the leprosy bacillus. At the time I had no direct proof of the mycotic nature of the leprosy organism. My conclusions were based on the fact that by culturing material from organs of rabbits that had died of infection with cultures obtained from leprous material,[2] I often obtained, besides colonies of acid-fast bacilli, actinomycetic growths in the substratum. Isolated colonies of the mycotic growth contained acid-fast rods, sometimes in considerable quantities, that persisted and multiplied, living there as symbionts in a number of generations. Consequently, I could not but suspect a genetic relation between these

[1] Read (abbreviated) at the Scientific Conference of the Tropical Institute and the Tuberculosis Section of the Association of Microbiologists, November–December, 1933.

[2] These cultures I considered then, and still do, to be genuine cultures of the leprosy "bacillus."

rods and the mycotic organism itself, especially since I was (and still am) confident of the faultlessness of my technic. Naturally, I realized that such observations, however convincing to me, might not convince others. There could be raised the objection that I was dealing with a contamination, and more convincing evidence was required.

Not until 1922, twelve years after the publication of the last of my main articles on the subject, did I have the opportunity to start work to obtain the necessary data. Since then I have collected an abundance of laboratory material, but the detailed study of it could not be taken up until recently. In the meantime these problems have begun, more and more, to attract the attention of other investigators. Therefore, I have decided to record the main facts of the observations which I have made over many years, presenting them in the form of summarized generalized conclusions. This communication is a third attempt to formulate my concepts in a generalized and somewhat schematic manner.[3] It is a study of the relationships between the various representatives of the large group of mycotic organisms that are known under the indefinite names of *Actinomyces, Streptothrix, Oöspora, Nocardia* (French authors), and also *Cladothrix,* which is quite incorrect and now seldom used.

While most infectious diseases have received more or less clear elucidation through clinical and microbiological studies during the last decade, our knowledge of the actinomycetic diseases and their causative germs remains about as it was thirty or forty years ago. Since the time of Petruschky we usually distinguish two forms of these diseases: (*a*) The actinomycoses, caused by organisms that give retort-shaped swellings and form compact radiating clumps (zoöglœa) that have been called druses; and (*b*) the streptothricoses, caused by mycotic organisms that do not give such swellings and druses, but form soft, sometimes starlike, interlacing, short filaments. Berestnev distinguishes the first of these as "typical actinomycosis," proposing the name "atypical actinomycosis" for those forms that are caused by a special variety of the mycotic organisms, morphologically very near to "streptothrix" but differing from it, like the tubercle bacillus, by being acid-fast. Finally, Savchenko has described a case of actinomycosislike disease caused by a rod-shaped microbe that produces druselike growths analogous to those of the filaments of actinomycetes.

[3] For the first two attempts see references 12 and 13.

If to the foregoing are added the well-known facts that the cultures of actinomycetes isolated by different authors can produce various pigments, that some actinomycetes can grow only aërobically and others only anaërobically, that pathogenic significance has been ascribed only to the latter, that the possibility of infection of animals with the mycelium is still doubtful, and finally that the actinomycetes are abundantly disseminated in the outside world, then we have practically exhausted the knowledge that we had until recently about the mysterious group of "filamentous-mycotic" organisms the study of which, in my opinion, will bring much new and unexpected knowledge to the science of microbiology. Only during recent years has the interest of microbiologists been attracted to this neglected field. The works pertaining to the subject are so few and disjointed that I shall not dwell on them, especially since, though written long after most of my own investigations had been completed, they add nothing new or unexpected.

II

In my investigations I used the actinomycetes or streptothrices (I consider these denominations identical) which I isolated from so-called pure cultures of tuberculosis and leprosy bacilli. I have isolated fifteen cultures of such actinomycetes—eleven from human tuberculosis, one from avian tuberculosis, and three from my strain of leprosy. The methods of obtaining these cultures will be published later; here I speak only of the cultures themselves.

At the very beginning of the work I was much surprised by an extremely important fact, one that was very puzzling and that caused me to question the correctness of my hypothesis and the exactness of my technic. This fact is that the cultures of actinomycetes that I isolated at different times from a given culture (for example, tuberculosis) gave such variegated pictures of growth that I could not classify them as of one definite type. Only many years later, after studying very many cultures, was I able to unriddle this phenomenon and to develop it on a systematic basis. The matter stands as follows:

If a typical culture of actinomycetes (as described in any textbook) is subcultured at short intervals (that is, one, two, or three months) in the same medium in which it has been grown, we obtain the growth that is typical for the culture: it forms a thick, very compact pellicle that is cut with difficulty,

adheres tenaciously to the substratum, and at a definite time becomes covered with a chalklike spore-bearing film. If, on the other hand, this same organism is subcultured on a medium poorer in nutrients (especially if there is an abundance of water of condensation), and, what is of the utmost importance, if the subcultures are made at longer intervals (nine, twelve, eighteen months), new changes take place in the picture of growth. Sometimes gradually, through a number of generations, sometimes suddenly, as if by mutation, the pellicle becomes soft and moist, forms folds that are sometimes oddly ornamental, is easily removed from the substratum and split by a spatula, though when slides are prepared the growth is emulsified with some difficulty.

If such a transformed variant is subcultured at this stage of its development on the same or a similar medium, it gives, on the whole, about the same picture of growth, with perhaps some small variations of detail. If, however, it is left alone, a very curious picture develops, which as far as I know has not been noted by anyone. The growth becomes of soft consistency, very moist, changing into a glasslike mucoid mass that covers the surface of the medium with a thin layer. When an attempt is made to scrape off part of it, it stretches into short filaments, easily emulsified on a slide. This mucuslike transformation of my cultures caused me a great deal of trouble, since it often ended by destruction of the actinomycetes if subcultures were not made in good time.

I have presented here only a general orientational scheme of the process noted. It is obvious that at different stages of its rather long development there are possible deviations as regards the peculiarities of growth of the cultures, but I feel warranted in speaking of a systematic nature of the phenomenon as a whole, as it has been observed in a large number of cultures.

Turning now to the morphological behavior of the actinomycetes in a gradually changing culture, we see the following picture: In the original culture the organism reveals, as usual, long, frequently branching filaments, with feltlike, thickly interwoven threads. In cultures that begin to soften, the threads show a tendency to undergo septation and to break up into separate segments. These segments are sometimes long, but sometimes they are so short that they cannot be distinguished from bacillar forms. In cultures that soften further, the septation becomes more pronounced and the number of short threads and bacillary forms increases, whereas the threads,

twisting spirochætelike, form loose starlike figures that remind one of similar starlike variants observed in cases of actinomycosis that grows without druse formation. Cultures that have become mucoid and dissolved consist for the most part of granular protein detritus with small amounts (varying according to the age and condition of the growth) of separate clumps—remnants of loose, interlaced filaments of the actinomycetes. Among the amorphous protein granules can sometimes be found considerable numbers of clearly defined, prominent but minute, dotlike granules, very like Paschen bodies as they appear in the cow-pox detritus after special staining. If observation is continued, after a short time the threads and filaments disappear altogether, and the whole content of the mucoid material that covers the surface of the medium consists of protein detritus, among the shapeless clumps of which are clearly distinguishable the regular minute à la Paschen granules.

During the process of these observations, which have been made many times, three features have attracted my attention:

(1) When the spores (oidia) taken from the chalklike, downy film are stained by the Ziehl-Neelsen method, some retain the red and some are blue. This is not true of all cultures that have aërial mycelia, but it has been observed quite frequently.

(2) At a definite period of their development the filaments of the actinomycetes become granular. The size of the granules is variable, starting from those with a diameter only slightly exceeding that of the threads, and ending with bodies that can be seen with the naked eye. This granule formation is seen in the separate parts of the threads, no matter how short they may be. Besides these granules encompassed within the threads, the cultures often reveal larger, free-lying, spherical bodies the diameter of which exceeds that of the threads by two or three times, and which stain intensely blue when double staining is used. I have not sufficient evidence to permit me to judge of the significance of these spherical formations or their relation to the filaments and the granules that are included in them.

(3) The threads of mycelium, as has been noted, may fragment into rod-shaped segments. To this phenomenon I have always ascribed the greatest significance. In it lies the key to further understanding of the genetic relationship between the actinomycetes and the diphtheroids. Consequently, I have concentrated mainly upon the study of these relations between the different representatives of the general group of microbes, at one end of which stand such complex forms as the actino-

mycetes and at the other (I have sufficient evidence to support this) such apparently simple microbes as the sarcinæ. The diphtheroid group occupies a middle position between the two.

III

The phenomenon of septation or fragmentation of the actinomycetic filaments into bacillary forms was noted long ago. Sometimes this change has occurred to such an extent that the number of rod-shaped forms in the culture greatly exceeded the amount of the thread forms. See, for example, Lieske,(16) figs. 18, 23, 25, 29, and 37. However, as far as I know none of the authors who noted this phenomenon suspected that rods can be obtained in pure culture, and that thus a bridge is thrown across the gap between the microbes of complex organization and those more simply organized. Even Lieske, who worked with the actinomycetes more than anyone else, went no further than the conclusion that the bacillary forms are "cylindrical spores" of the mycotic organisms. Marie Triuss and Elena Politova(21) came nearer to the nature of this phenomenon; they dissociated into segments, both in vivo and in vitro, the mycotic organisms obtained from ordinary cases of actinomycosis. Unfortunately, their valuable investigations are incomplete, mainly in the lack of cultures of the rods obtained through dissociation, and also in the lack of histologic pictures from experimental animals. However, they gave a correct analysis of the genetic relation that exists between the mycotic organisms and the rods dissociated from them, both acid-susceptible and acid-fast.

The same idea of this relation is presented in the works of Karwacki,(9) who observed fragmentation in the cultures of streptothrices, which he often isolated from tuberculosis material. More guardedly, but with sufficient confidence, the same question is discussed by Jensen,(8) who isolated from Australian soil two strains of a microbe that "exhibited characters belonging to both the genera *Actinomyces* and *Mycobacterium*, which are not very well separated from each other. In quite young cultures it formed branching filaments, which soon broke up into short, rod-shaped, partly acid-fast elements, so that in this stage the organism could not be distinguished from the ordinary saprophytic mycobacteria." However, the old cultures (four to five weeks) produced "spots of white aërial mycelium," and by plating from this mycelium cultures were obtained which

consisted of "richly branching mycelium, entirely actinomyces-like, without any tendency to spontaneous fragmentation."

In my communication published in 1910,(11) plate 11 presents six figures illustrating the fragmentation of the filaments of microörganisms isolated from experimental animals into separate rods, lying either free or collected into small groups. These pictures, which I saw many times in material from the lower part of the cultures that was usually washed off by the water of condensation and comparatively quickly softened, first led me to think that here might be found proof of a genetic relation between the actinomycetes and the diphtheroids.

A further stimulus in this direction was received in 1923 when, with the aid of G. E. Platonov and the use of his method, I isolated for the first time from a culture of human-type tuberculosis a culture of actinomycetes. From the first this culture was of soft consistency, and on solid media exhibited a moist growth of brownish color, with folds that sometimes became covered with a white, chalklike, spore-bearing layer. The film could easily be removed from the medium or split with a spatula, and was comparatively easily emulsified. Under the microscope the culture consisted of loosely interlaced threads that bore on their ends rows of rod-shaped segments, of which abundant quantities were seen throughout the culture.

In broth-tube cultures the growth exhibited a peculiar feature, which I had seen before in studying actinomycetes isolated from ordinary cases of actinomycosis. The growth appeared at the bottom of the tube, forming a number of spherical colonies 3 to 5 mm in diameter (zoöglœa, consisting of interlaced filaments of mycotic organisms), which in a few days rose as a beaded, broken chain along the side of the tube, reaching the surface of the broth. At the surface at the place where the liquid touches the glass it formed a film that rose 2 to 3 mm along the glass and gradually spread over the entire surface of the medium. The globular colonies were of quite regular form, but of variable consistency; they were sometimes compact and opaque, sometimes soft and so transparent that in transmitted light their feltlike structure was easily distinguishable. These masses were undoubtedly fastened to the glass, but so loosely that at the slightest jar they were shaken loose and fell to the bottom at a speed dependent upon their relative specific gravity. At the same time the pellicle that developed on the surface became more compact, and so adherent to the glass that some effort was re-

quired to shake it off, after which it fell to the bottom. Within a short time a new pellicle usually appeared, but in most cases this was much thinner and softer than the first.

The same features were seen, but more conspicuously, when the organism was cultivated in a small flask (150 to 200 cc) half filled with the broth. The globular masses appeared in larger numbers and they were much larger in size, but otherwise the whole process seen in the tubes occurred here. The compact masses were brownish; the soft, transparent ones were almost flocculent; and intermediate forms were seen. Not until much later did I fully appreciate the significance of this observation. It gave evidence of the segmentation of the actinomycetes into a number of separate variants, for it was found that these different globes, removed (by one way or another) and transferred to solid media, gave rise to new cultures that differed from one another in many ways—being sometimes compact and smooth, and sometimes wrinkled and soft, with variations to one side or the other.

If the flask was periodically shaken, the softest of the globes were changed into flakes that became smaller and smaller, and the broth became turbid. Microscopically the flakes and soft globes consisted of comparatively short threads, either lying free or softly interlaced, but often separated into short rodlike segments, which are partly lying free. By the method of "fractional culture," which I employed long before it came into common use under the name of "dissociation," these rod-shaped elements could be isolated, though not without some difficulty.

Even more convincingly the same results were obtained in the study of the isolated mycotic organisms. It was found that a culture, if subcultured regularly (every two or three weeks) on solid media (agar and potato), invariably gave the same type of growth. However, the original growth that remained for three months without being subcultured underwent a change, the film becoming moist and softer. When the growth was transferred into broth, so that part of the material remained floating on the surface, an interesting picture was noted, which I will give here in the way it was noted in the protocol. The observation was made in 1923.

OBSERVATION 1

March 3. Culture in flask, dextrose broth. Thermostat.

March 6. Slight growth; separate, small (pinhead size), compact, brownish colonies that have developed peripherially on the

surface of the medium and are adherent to the glass. The plated film is slightly increased circumferentially, forming a thin, delicate ring around the edge.

March 16. The number of colony dots increased. The ring around the plated pellicle wider.

March 19. On the glass at the surface of the medium is a complete ring of confluent small colonies. A thin, semitransparent film covers almost the entire surface. On it are islets of a thin, white, spore-bearing, downy coating.

March 23. The ring on the glass is wider and more compact. A chalklike down in the form of multiple colonies covers the greater part of the film.

March 27. The film, fusing with the peripherial ring, covers the entire surface. It is covered by a thick layer of chalklike coating. Broth still clear.

March 29. The film has separated from the glass and is partly immersed. Wetted by the broth, the chalklike down has become moist. The broth is turbid.

April 7. The film is fully immersed, the broth turbid.

April 11. On the surface is a new film, thinner and more transparent than the first, as if the medium were covered by a thin layer of paraffin.

April 20. No change. No down on the surface of the film.

Microscopically almost the same forms were found in both the film and the broth: threads that break up into coccoid and rod-shaped forms, and free-lying "coccoids" and rods. By fractional culture on dextrose, glycerin, and plain agar in tubes (not on plates) the rods were isolated without difficulty into separate cultures. They exhibited all the characteristics belonging to the diphtheroid group.

This experiment was repeated four times, always with the same results. Before the work was started the original culture was repeatedly "purified" by plate subcultures. I had no opportunity at that time to apply the Burri method or to employ the micromanipulator.[4]

Thus, twenty years ago I had proof that the complex mycotic organisms of the *Actinomyces* type can be broken up (or, using

[4] It was demonstrated later that the phenomenon of softening of the film appeared earlier or later in any subculture from the original culture in a number of strains of the actinomycetes. These observations, made in 1923 and 1924, served as the starting point for further investigations in the same line that permitted me to establish the systematic nature of the observed phenomenon which I have described.

the modern terminology, dissociated) into simpler elements. I did not wish, however, to publish my observation then, as it was made at a time when the "monomorphistic" views prevailed, and a report published at that time would be lost among other "incidental" papers. Moreover, it referred only to one strain of actinomycetes, the origin of which might be considered doubtful from the beginning. It was only much later, when working with other actinomycetes isolated from acid-fast cultures, that I became fully convinced of the systematic nature of the phenomenon.

At the same time, studying in detail these less complexly organized elements, which were obtained by dissociation, I became convinced that, from their morphologic and cultural characteristics, they can be included in the group of microbes that Babes first proposed to designate as "diphtherideen," and which I later referred to as "diphtheroids." I do not wish to give here an exact definition of this group of microbes—it becomes more or less clear without it—but only to point out that among various representatives of this group there are wide variations in morphologic features and, it may be supposed, a priori, in biologic characteristics. To this class of organisms must be added the large group of acid-fast bacilli (including those of tuberculosis and leprosy), in view of the possibility of their existence in a non-acid-fast form.

IV

The phenomena described above, in spite of the fact that they promised large perspectives for further investigation, did not satisfy me for the reason that the main ultimate purpose of my investigations was to produce irrefutable proofs in favor of my old view with regard to the mycotic nature of the tuberculosis and leprosy bacilli. These proofs, in my opinion, could be obtained by investigations in two directions: (*a*) Inoculation of actinomycetes to cause a tuberculosislike disease and (*b*) attempts to transform a non-acid-fast diphtheroid isolated from the cultures of actinomycetes into an acid-fast form in vivo or in vitro. The first task I completed in 1926; the second was successfully solved under my guidance by N. V. Galanova, in 1933 and 1934. My personal experience was as follows:

OBSERVATION 2

April 13. A cranial trepanation was made in a rabbit weighing 2,000 grams.

April 19. Through the trephine opening a rich emulsion of a two-weeks' culture of actinomycetes was injected. The culture had been obtained one and one-half years previously from an old culture of human tuberculosis by W. A. Krestovnikova, of the Mechnikov Institute. The culture ("*Actinomyces K.*") was grown in the thermostat, then kept at room temperature, and subcultured from time to time at intervals of one to two months.

August 3. The rabbit showed paresis of the hind legs. After a few days this passed into full paralysis. In view of the development of an ulcer the rabbit was killed (air embolus). At autopsy, besides a small ulcer on the scrotum, there were also noted: A few small milletlike tubercles disseminated under the pleura of the right lung and part of the left lung; a considerable number of similar but smaller tubercles (from pin-head size to just visible to the naked eye) in the subserosa of the cæcum and the blind end of the sacculus rotundus; a larger number of tubercles disseminated in the subserosa of the rectum.[5] The upper part of the right epididymis had an oval nodule, 0.7 by 0.4 cm, with caseous necrosis. One of the right inguinal lymph nodes was enlarged (0.5 by 0.3 cm); three others (one on the right and two on the left) had increased very little if at all.

Under the microscope all the tuberclelike formations in the intestines consisted of clumps of epithelioid cells that formed larger or smaller islets, the larger of which had undergone caseous degeneration centrally (Plate 1, figs. 1 and 2). The islets were situated in the adenoid tissue, with which the mucous membrane of the colon and appendix (sacculus rotundus) of the rabbit is so rich. On studying the smallest of these islets a definite impression was gained that they originated from reticulocytes of this adenoid tissue. The islets were mostly round or oval, very regularly defined, and only in the rectum (where the adenoid tissue is scant or absent) they became irregular or triangular, spreading on both sides along the large lymphatic vessels that pass between the different layers of the intestinal wall. The caseous nodule of the epididymis proved to consist entirely of epithelioid tissue the greater part of which, starting from the center, had undergone necrosis. In the lymph nodes the same clumps of epithelioid cells were noted, forming either small, almost rudimentary, round or oval islets that

[5] Most of these nodules were hidden by the smooth surface of the intestines; only a few of them, the largest, raised slightly the serous surface.

developed in the follicles, or larger islets of irregular form that developed in the sinuses. In the large gland was also found hyperplasia of the entire lymphoid tissue that distorted the structure of the gland and caused marked dilatation of the blood vessels of the hiluses. Small round or oval islets of epithelioid cells were found also in the liver and spleen, with an admixture of "round" cells in the former organ. Comparatively large nodules of the same structure with a definite tendency towards necrosis were found in the lungs under the pleura, and sometimes on the pleura itself. On using the Ziehl-Neelsen stain acid-fast bacilli were found in the affected areas, and it is interesting to note that the older the process the greater was the number of bacilli. In the spinal cord changes were found in the soft meninges, the medullary tissue, and the roots of the nerve fibers that go from the cord. These were small nodules of regular form, consisting of epithelioid cells, together with quite large lesions ending in caseous necrosis (Plate 2, figs. 3 and 4). The Ziehl-Neelsen stain revealed in these lesions also the presence of acid-fast bacilli of the type of tubercule bacilli.

The significance of these findings is clear. The actinomycetes obtained from a tuberculosis culture, injected into the brain of the rabbit, "dissociated" into bacillary elements that in the living medium again acquired their old biochemical characters and caused a number of lesions that were completely similar to the changes that are caused by tuberculosis.[6]

The changes noted in this case, especially in the spinal cord and the intestinal wall, are much like those obtained by inoculating into a rabbit a non-acid-fast diphtheroid that I had isolated from leprous nodules.[7] In both cases the lesions were chiefly in the lumbar part of the spinal cord and the lymphoid tissue of certain parts of the intestines; they contained areas of epithelioid tissue with a more or less definite tendency to caseous necrosis, and they revealed very similar acid-fast bacilli. However, there was an essential difference with regard to the numbers of bacilli and especially their relations to the epithelioid cells. In the case of leprosy the bacilli were very numerous and mostly situated inside the epithelioid cells around the rarefied areas of the cytoplasm; in the tuberculosis material the bacilli were comparatively very few and they were found mostly free of the

[6] Unfortunately, because of technical conditions, I could not obtain from the experimental animal a strain of the bacilli; no attempt was made to culture them further on laboratory media.

[7] See my 1910 communication(11) photographs 1 to 4, 34, 35 and fig. 55.

cells, and when occasionally they were inside the epithelioid cells the number was small—two, five, or seven in a cell. There were also other essential differences. In the leprosy material the changes were found mostly in the soft meninges, from which the process started; in the tuberculosis material the principal lesions were in the medullary tissue itself; though here, also, the process evidently started from the soft meninges. In leprosy the tendency to necrotic change was slight; in tuberculosis this tendency was more apparent.

The observations of Galanova were as follows: By fractional subculturing on plates she isolated a non-acid-fast diphtheroid from a culture of actinomycetes, and by growing it in milk she transformed it into an acid-fast stage. These organisms inoculated into animals caused the appearance of disseminated tubercles. Similar experiments have been carried out with a diphtheroid isolated from a culture of the human tuberculosis bacillus.

OBSERVATION 3

In 1932 I isolated from a "classical" culture of tuberculosis, obtained the year before from the sputum of a patient, a culture of actinomycetes (N 290) that gave on potato a crumbly, granular growth that appeared as a yellowish sponge, slightly raised on the surface of the medium. The growth was easily split, emulsified comparatively easily, and from the first was rich in segmented threads that at the ends broke up into a number of short, rod-shaped segments. Shortly afterwards the growth became moist (beginning of lysis) and the number of rod-shaped elements increased. On plating from these, Galanova isolated a number of colonies of granular, non-acid-fast rods of diphtheroid type. The corresponding cultures were designated N 290 D_1, D_2, and D_3.

Beginning April 6, 1933, these three cultures were subcultured in milk and every five to seven days were examined microscopically and new cultures made. On the seventh passage, in D_1, acid-fast rods were noted for the first time. The numbers of these increased in further cultures (nine or ten) to such an extent that subcultures of them on glycerin agar and on serum-nutrose-glycerin agar (Wassermann) gave growths that consisted mostly of that form. These cultures at first grew quite rapidly (eight to ten days), looked slightly moist (that is, had a homogeneous appearance), and contained a smaller or greater admixture of non-acid-fast forms. At present, however, they grow much more slowly, are much drier, and on the whole do not differ from the

ordinary ("typical") cultures of human tuberculosis. The diphtheroids D_1 that were not passed through milk remained in their former non-acid-fast state. In D_2 the numbers of acid-fast forms varied greatly but at most were comparatively limited, and when transferred to solid media only strains of non-acid-fast rods were obtained. Unfortunately, due to technical conditions, investigations with this strain had to be interrupted prematurely. In D_3, if acid-fast organisms appeared at all in some passages, their numbers were very small. All three diphtheroids, not passed through milk and subcultured only on solid media (the Wassermann agar included), have remained non-acid-fast to the present time.

December 1, 1933, the acid-fast strain D_1 isolated from milk was inoculated into a guinea pig (weight 310 g). The growth on agar was washed off with saline and the emulsion diluted to a titer of 2 milliards. One cc was injected into the peritoneal cavity.

March 23, 1934, the animal died. There was frank tuberculosis with large caseous nodules in the liver, spleen, omentum, and lymph nodes. Cultures on Hohn medium, Wassermann medium, and glycerin potato gave ordinary growths of tubercle bacilli.

OBSERVATION 4

In 1925 I received from S. I. Guinzburg, of the Mechnikov Institute (Moscow), a typical culture of tuberculosis. At present, after many years of cultivation, not always done regularly, it exhibits a moist, mucoid appearance ("homogeneous" of Arloing-Courmont). Microscopically it has sometimes shown an admixture, at times quite notable, of non-acid-fast bacilli. Galanova isolated from this culture four colonies of non-acid-fast diphtheroids, designated as GD_1, GD_2, GD_3, and GD_4.

March 23, 1933. These growths were transferred to milk. On the ninth day the diphtheroids in all tubes showed no change, but on the sixteenth day tube D_1 contained about 50 per cent acid-fasts. However, a fractional subculture on plates (April 10) gave only eight colonies of diphtheroids and none of acid-fast organisms.

April 16. The eight colonies referred to were again subcultured in milk. After seven days all tubes contained an admixture of acid-fasts. Transfers to glycerin agar gave only diphtheroids except in one tube, which on the fourteenth day showed a wrinkled, dry film that crumbled on emulsification.

Under the microscope this consisted of red granular rods identical with tubercle bacilli. The new culture is designated as the original one, D_1.

In strain D_2 acid-fast forms began to appear only after the sixteenth passage, and these gradually increased until after the twenty-fourth passage a subculture on Wassermann agar gave a growth of acid-fast microbes with only a small admixture of non-acid-fast bacilli.

Two guinea pigs (weight 265 and 230 g) were inoculated January 1, 1934, with cultures D_1 and D_2. Because of lack of animals the material inoculated was a mixture of the two cultures. The dosage and route were as in observation 3. One guinea pig died January 30, and the other, March 23. Both animals showed the ordinary picture of general tuberculosis, more marked in the second one. From the liver of this second animal, and from an enlarged caseous lymph node of the first, tubercle bacilli were isolated.

These last observations give me the right to draw a definite conclusion. Granting that my experiment with the rabbit was not conclusive, since the filamentous mass of the actinomycetes might also have contained tubercle bacilli from the culture from which the actinomycetes was grown, the last two observations completely avoid that possible complication.

V

Summing up my numerous observations, I conclude with a certain degree of satisfaction that the principal object of my work—to establish the mycotic nature of the causative organism of tuberculosis and leprosy—is in the main completed. But in the course of this work there have arisen, quite incidentally but none the less insistently, two important questions that I believe will become the subject of detailed study in the near future: (*a*) One of these questions concerns the reversibility of some of the phenomena that I have observed; (*b*) the other is with regard to pigment formation.

The first question may be itself divided into two parts: (*a*) The reversibility of diphtheroids into actinomycetes, and (*b*) reversion within the group of actinomycetes itself from the more "degraded" forms to the more vigorous ones which, in agreement with Berestnev, I designate as "typical." With regard to the first part of this question, having no personal observations I can only refer to the literature on the subject, pointing out the

work of Cache,[6] Spirig,[20] and Brullova,[5] who proved the possibility of transforming the diphtheria and pseudodiphtheria bacilli into actinomycetes. For my own part, I can add that the possibility of reverting acid-fast "bacteria" into actinomycete-like forms serves as a positive answer to the above question. As for the second part of the question, the matter is much simpler if the nature of the process is not considered. I have succeeded in reverting my weak (atypical) cultures of the actinomycetes into vigorous (typical) cultures by employing various methods:

1. By selection of the cultures. This method can be employed with both solid and fluid media. In the numerous subcultures that I have had at my disposal (made for the purpose of preserving the strains and their substrains) I often observed that the same culture, even when growing on the same medium but more noticeably when on different media (agar, serum-nutrose-agar, simple and glycerin potato), gave growths that sometimes appeared more or less compact and sometimes soft and mucoid. Obviously, to preserve the culture the first modification was used. Fluid media could also be used with success, at least in some instances. As has been said, the actinomycetes when cultured in broth gave "globe-colonies" of varying compactness. When transferred to solid media the more compact colonies gave rise to the more vigorous and persistent growths.

2. By growing cultures under conditions more favorable for their development. I refer here to frequent revival of the cultures by subculturing in media rich in nutrients, mainly serum media; egg media seem to be unsuitable. Cultures which, because of ageing (infrequent subculturing), produced lysogenic substances, appeared degraded, and tended to perish, could by frequent transfers on favorable media be restored to their original vigorous condition. This phenomenon I consider common for the entire genus *Actinomyces*.

3. By "revivification" of the entire culture. As has been said, because of lack of proper care my cultures often retrogressed to such an extent that further transfers gave no growth. I attempted to revive them by carefully adding sterile broth. This was done many scores of times. In only two instances I obtained a new growth that was far more vigorous than the original one, and appeared as a thick, compact film that split with difficulty. In the other instances when any success at all was obtained by this method the new growth was of about the same character as the original one.

4. The fourth method that I employed with success with one culture is so new and peculiar that I present here the protocol of the experiment. The observation was made in 1925.

OBSERVATION 5

By growing a culture of human tuberculosis on a richly alkalinized slice of carrot, prepared according to the method of Kumbary,(15) I obtained a strain of actinomycetes even more "degraded" [8] (that is, appearing softer and more unstable) than the one described in observation 1. It gave no growth at all on either plain potato or glycerin-potato media. In ordinary dextrose and glycerin agar, and also on Wassermann serum-nutrose-glycerin agar, it gave a growth that will be described later. In broth media its behavior was peculiar. In broth prepared by me personally [9] it either gave no growth or only a scant one, a very few transparent globe colonies, which soon dissolved altogether. In broth from the Mechnikov Institute the growth appeared as a limited number of large globes, or a large number of small ones, more compact than in my broth, that were usually seen at the bottom of the tube. In the first case the globes, within two to four days of their appearance, were either dissolved entirely or changed into a mucoid, adherent mass that on shaking was removed with difficulty from contact with the tube; this material also dissolved in the course of a few days. In the second case the globes rapidly grew along the side of the tube as if clinging to an invisible ladder, and within the first twenty-four hours usually reached the surface of the broth. There they showed a definite tendency to adhere more firmly to the glass and gave a ringlike or wheellike growth. However, this connection with the glass surface, as in observation 1, was very unstable and the slightest shaking of the tube was sufficient to cause all the globes and the upper wheel to separate and fall to the bottom of the tube. By the second day the growth had either dissolved entirely, or a part had dissolved while the rest formed a transparent mucoid mass that on vigorous shaking caused a grayish cloud. This soon gravitated again and dissolved in the course of a few

[8] I use this designation conditionally as yet, though I have justification for using it definitively.

[9] The laboratory in which I then worked was so short of assistants that I was obliged to prepare the media myself. At the same time I sometimes used, on permission of the director, media made in the Mechnikov Institute.

days. What caused the difference in behavior in the two lots of broth used I cannot say, but it may have been difference in alkalinity; my broth was 7.4 to 7.6 pH, while the other (according to Michaelis) was 7.0 to 7.2.

Transferred to the Kumbary carrot, on which it had originally been grown, the globes gave a very scant growth, which appeared as a soft, wrinkled, black-pigmented film. This quickly dissolved and left a corresponding black stain. On dextrose or glycerin agar the globes wrinkled up into small clumps of irregular form, around which on the following day there was a grayish, usually narrow, border forming an accurately circumscribed disk. This occupied, as if impregnating, the upper layers of the agar and produced from its lower surface (when the tube was in the horizontal position) a segment equal to from one-quarter to one-half of the globe that penetrated into the substratum. This tendency of the fungus to develop anaërobically in the substratum of the solid medium was puzzling, for it was contradictory to its tendency when in broth to grow upward to the surface, where it underwent further development; that is, revealed aërotaxis. On agar, on the other hand, the colony not only penetrated the medium but seemed as if pressed into it, for the disklike free surface seldom remained smooth but usually showed a rosette-shaped design on account of a number of small furrows that radiated peripherally from the clump lying in the center (remnants of the transplanted globe). The freshly grown colonies gave the impression of definite vitality, of ability to develop further, but on the day following their appearance they faded, becoming clearer and glasslike, and further cultures on the same medium gave no growth.

The same thing was seen on the Wassermann agar, except that the colonies were on the average much larger, were whiter, and seemed more compact and opaque, and clarification was less clearly seen. However, in subcultures there was no improvement in the viability of the growth, and for the purpose of preserving the culture this medium proved as useless as the sugar agar.

The surprising fragility and instability of this organism led me to an attempt to verify my old conception that these microbes can recover their former vigorous characteristics. The most promising method seemed to be frequent subculturing on media rich in nutrients. For this purpose, under existing circumstances, it was most convenient to use the Wassermann agar.

From a culture in dextrose broth, into which there was often added one-fourth to one-third of the Wassermann nutrose serum, I transferred the more compact globes to Wassermann agar. Because of the tendency of the globes to autolysis such subcultures had to be made from fresh cultures, from the first to the third day after the globes appeared. Two or three globes (whole globe, or at least a half one in each instance) were transferred to each tube and placed at a distance from each other. Though more than 150 such subcultures were made during the winter of 1925,[10] in not a single tube did the desired revival occur. The colonies that grew around the transferred clumps at first gave the impression of some vigor, but after two or three days they became paler, under the influence of dissolution that usually started from the center of the disk in the upper layers of the medium and extended down into the deeper layers of the colonies.

Parallel observations were then started with fluid media: Ordinary broth, glycerine broth, and especially dextrose broth (all from the Mechnikov Institute), both unmodified and with Wassermann nutrose serum. In spite of a great many subcultures, made almost daily (a total of 546 subcultures were made on solid and fluid media during the winter of 1925 and 1926), this method also gave no encouraging results. In the new media the globes became more resistant to dissolution, retaining their original characters for ten to fifteen days, but then they changed into homogeneous mucoid masses and sooner or later dissolved entirely, leaving an amorphous crumbly sediment.

These failures continued until I concentrated attention upon the fact that the ring of growth that developed against the tube wall at the surface, where it was best aërated, appeared to be more compact than the globes from which it originated. Assuming that the compactness might increase if this growth were left in place for a few days, I inoculated five sugar-broth tubes and left them in the thermostat for several days, protected from shaking. After five days there was found in three tubes a very compact surface pellicle, firmly adherent to the glass and covered by a thick layer of chalklike, spore-bearing down. In other words, the growth acquired, as further study revealed, all the characteristics of a "typical" culture of *Actinomyces*. This cul-

[10] Sixty experiments were made, and in each not less than two or three tubes were inoculated.

ture was designated "*Actinomyces N. 137.*" In the other tubes the film was drowned.

VI

The second question, that of pigment formation, I can touch on only slightly, as my observations on the matter were only incidental, made in connection with the numerous subcultures of actinomycetes that I have isolated.

The time has not yet passed when special practical significance has been assigned to pigment formation as a definite characteristic of one or another race of a particular microbic genus. An example is the classification of the staphylococci in accordance with their pigmentation, and the sarcinæ afford another. With regard to the large groups of the so-called paratuberculosis bacilli, the mycobacteria (the acid-fast saprophytes—butter and lacticola bacilli of Petri, Rabinovitch, Korn, and others, Möller's grass bacilli, and manure bacilli), it has been thought possible to distinguish the individual "representatives" by their cultural properties and pigment formation. However, it is now known that pigment formation in the mycobacteria is subject to most peculiar variations, and that the pigmented strains can change into nonpigmented ones and vice versa, just as pigmented bacteria of other kinds can be transformed—for example, the yellow sarcina into a white or orange form. Among the acid-fast saprophytes I have observed such profound changes within the same genus (referring to pigment formation and other cultural properties), that I am obliged to agree with the somewhat jocular remark of Frey and Hagan(7) that, in the museum collections of acid-fast cultures, ". . . as long as the labels remain on the tubes, one can distinguish these cultures, one from another, but if the label happens to be destroyed or lost, one would have no way of determining the identity of the culture."

There is no doubt in my mind that the same is true with regard to the actinomycetes. Their cultural properties are so changeable and unstable that to use them as a basis for distinguishing the mycotic organisms obtained—for example, from cultures of human tuberculosis or from organisms obtained from avian tuberculosis, or even from the organisms isolated from cultures of leprosy—is almost if not quite impossible. As regards pigment formation, its inconstancy and variability in the actinomycetes group are quite surprising. Pigment sometimes appears, sometimes disappears, sometimes changes into another

color, all this happening against the will of the person working with the organisms in the course of their routine subculturing. Most often I have observed the appearance of black and dark violet pigmentation, somewhat more seldom yellow, rose, and orange, still more seldom green, and only exceptionally red.[11]

VII

The observations of Triuss and Politova(21) that have been referred to bring up a question of great importance, the relation of the actinomycetes isolated from cases of "banal" radiant mycotic diseases to the tuberculosis bacillus. At the same time my observations bring out the question of the relation of mycotic organisms isolated from tuberculosis material to those of similar nature isolated by me and other authors (Williams, Rost, Reenstierna, Bayon) from leprous lesions or from cultures of leprosy (Kedrowsky), as well as the correlation between the various types of tubercle bacilli (human, bovine, and avian). In short, a new chapter in microbiology is being opened up that so far has remained in almost complete oblivion, that of the correlation of individual representatives of the actinomycetes group isolated from various sources, not excluding the saprophytes. As yet this chapter is only in project, but one need not be a prophet to foretell that a study of these questions will enrich science. To me it seems that the new knowledge that will be acquired will lead, first, towards revision of modern conceptions regarding the epidemiology, if not of tuberculosis, in any case of leprosy.(14) At the same time the observations of Boulkin and Glouchovzev demonstrate that the actinomycetes isolated from leprous material may successfully be used for preparation of antigens for the diagnosis of leprosy.

The findings of Triuss and Politova are strikingly peculiar and unexpected, and at present can hardly be accepted without essential reservations, although they deserve special attention. However, the sixth experiment that they report is in line with my own experience. From the pus of a cold abscess that contained a scanty amount of acid-fast (tuberculosis) bacilli these authors isolated a strain of actinomycetes which caused disseminated miliary tuberculosis in a guinea pig. In smears from the internal organs of the animal there were found only acid-fast rods of the tubercle type. It is obvious that this experiment

[11] Red pigment was observed in a culture of actinomycetes isolated by my collaborator A. K. Boulkin directly from leprous material.

is fully analogous to my experience of inoculation of a rabbit with the actinomycetes isolated from a tuberculosis culture.

SUMMARY

1. There is no necessity to divide the group of "filamentous mycotic organisms" into streptothrices and actinomycetes. There exists only one large general group, which may be designated either *Actinomyces* or *Streptothrix*.

2. Besides the cultures of these organisms that may be characterized as "typical," there exist in this group many variant forms that differ both from the basic (typical) strain and from each other by their morphological, cultural, and possibly biochemical properties.

3. In the development of such variant forms, outside of dissociation of the main trunk, an important part is evidently played by lysogenic substances that are formed as the culture ages. The action of these substances can be observed microscopically in fresh preparations in a change of refraction in the filaments; in stained slides the dissolving threads stain either very poorly or not at all.

4. Some of these variants are so "weak" and "unstable" that they become dissolved very soon after growth has started. This can be clearly observed in fluid media. However, even such extremely "degraded" variants can be reverted to the original, "typical" state by different methods. The process of "dissociation" is therefore a reversible phenomenon.

5. The formation of pigment being a very unstable and inconstant function, it cannot serve as a basis for differentiation in this group or in that of the acid-fast saprophytic diphtheroids. Therefore, the designations of the old authors, as "*Actinomyces rosaceus, niger, violaceus, albidofuscus, polychromogenes,*" etc., must be discarded.

6. The filaments of the actinomycetes, under conditions the nature of which is not yet quite clear, have the ability to break up into rod-shaped elements that can be isolated as individual cultures. Whether or not this represents what is known as "cyclogeny" or "periodicity in the life status" I cannot say, as I lack personal experience in that field.

7. Isolated in pure culture, the rods exhibit properties characteristic of the diphtheroid microbes, from which they have received the name "diphtherideen" or "diphtheroids."

8. On the basis of my observations and data already existing, I feel justified in making the general statement that a very

close genetic relationship exists between the actinomycetes and the diphtheroids.

9. The fact that the bacilli of tuberculosis and leprosy, supposedly or actually deprived of their acid-fastness, reveal all the characteristics of diphtheroid microbes, provides additional though indirect proof in favor of my old conception that tuberculosis and leprosy are diseases of mycotic origin.

10. Diphtheroids originating from a tuberculosis source can, by being cultured in milk, be transformed into an acid-fast condition, and in that state they cause typical manifestations of tuberculosis in experimental animals.

11. An actinomycete isolated from a tuberculosis culture "dissociated" in the body of the rabbit into acid-fast rods that caused lesions typical of tuberculosis.

12. I consider it more than probable that the Koch "bacilli" and the Hansen "bacilli" can change, while in the outside medium, into a more stable condition of a more highly differentiated, mycotic nature that stands nearer to the molds. The epidemiologic significance of this phenomenon, for tuberculosis and especially for leprosy, must be considered very great.

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ILLUSTRATIONS

PLATE 1

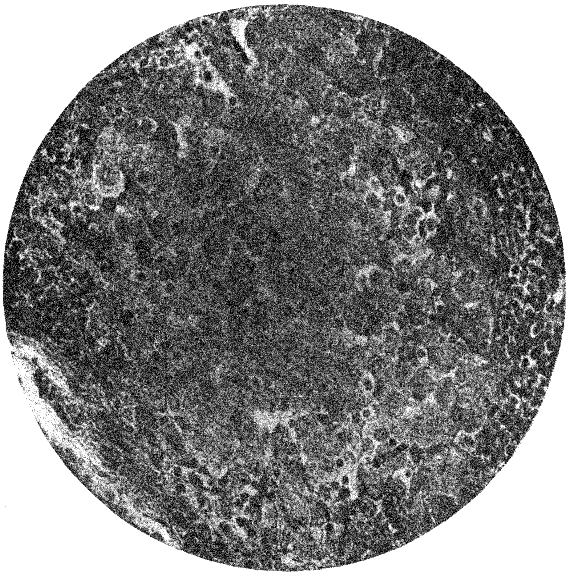
FIG. 1. Small nodule of epithelioid cells in submucosa of colon (1:300).

2. Larger tubercle with caseous degeneration in the center in submucosa of colon (1:150).

PLATE 2

FIG. 3. Tubercular islet with caseous degeneration in the peripheral part of the spinal cord (1:125).

4. Epithelioid nodule in the spinal root (1:300).



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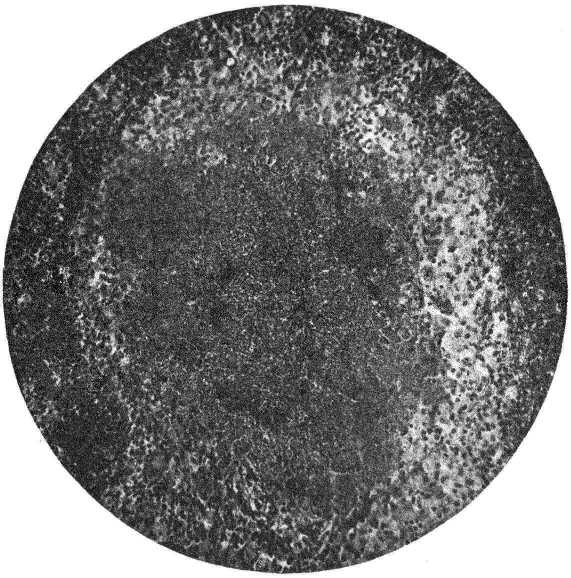

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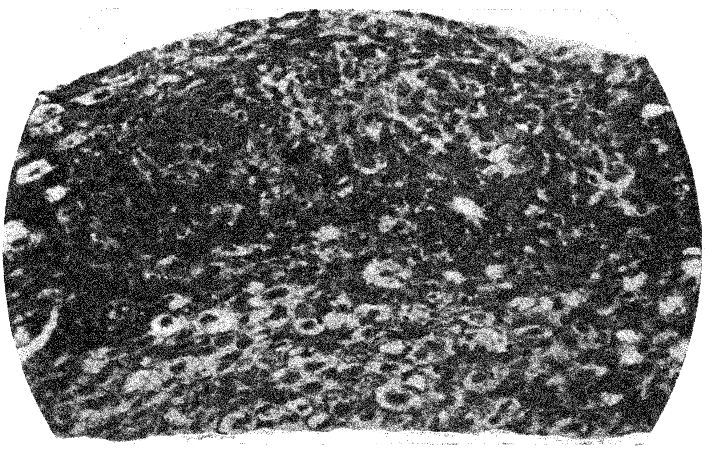
PLATE 1.

3



4

PLATE 2.

A CHECK LIST OF PHILIPPINE CRUSTACEAN DECAPODS

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INTRODUCTION

This work is primarily an attempt to survey the extent of the work done in the past on the systematic study on the Philippine carcinological fauna. At the same time, it may give an idea as to how much is yet to be done. The list is limited to the decapods, as very little has been done on the systematic study of the lower forms.

Of the 507 species included in this list, and distributed among 55 families and 195 genera, only 216 are in the collections of the University of the Philippines and the Bureau of Science. The remaining 291 species are not met with in the Philippines.

When all of the several hundreds of still unidentified specimens in the collection of both the University of the Philippines and the Bureau of Science are classified, and after extensive systematic surveying has been done, the number of species in the Philippine carcinological decapod fauna will undoubtedly be much greater than the number actually listed here.

Our present knowledge regarding our fauna is very meager. So far, no extensive systematic survey has been undertaken—neither by the government nor by private institutions. What we know of our carcinological fauna is the result of mere scrapings from here and there in a vast field that has hardly been touched. The species mentioned in the reports of such surveys as the Challenger Expedition, 1873–1876; the Voyage of H. M. S. Samarang, 1799–1877; the Siboga Expedition; the Exploration Expedition conducted by the U. S. Fisheries Steamer Albatross, were obtained from few places in the Philippines.

Active and persistent workers and investigators in this big and interesting group are still lacking. The few who are interested have had only limited time to give to this study. Among them were Doctor Cowles, former head of the Department of Zoölogy, University of the Philippines, whose work on Philippine palæmons is a distinct local contribution; Mr. Florencio

Talavera, who is responsible for the identification of most of the specimens in the collection of the Bureau of Science; Mr. Guillermo Blanco, of the same bureau, who has recently published a paper on Philippine Atyidæ [1]; Mr. Jose V. Yapchiongco, of the Department of Zoölogy, University of the Philippines, who has just completed his manuscript on Philippine Paguridea.

The species included in the list are in the collection of the Zoölogy Department, University of the Philippines; in the collection of the Fish and Game Administration, Bureau of Science; and a few are in the collection of the Northern Luzon Junior College at Vigan, Ilocos Sur. Specimens bearing tag numbers having a dash after the first digit as 0–56, belong to the Zoölogy Department, University of the Philippines; those whose tag numbers have no dash, like 0256, belong to the Bureau of Science. A few that do not bear tag numbers are in the collection of the Northern Luzon Junior College. Those that are reported only in foreign literatures are otherwise indicated.

ACKNOWLEDGMENT

This work was made possible through the kindness of Dr. Hilario A. Roxas, head of the Fish and Game Administration of the Bureau of Science. Doctor Roxas allowed me to go through the records and collection of the Bureau of Science and gave me all the help and facilities at his disposal. To Mr. Florencio Talavera, I owe very valuable help and suggestions.

SYSTEMATIC DISCUSSION

Various systems have been proposed for the classification of Macrura; namely, that of Latreille in 1831; that of Milne Edwards in 1837; that of de Haan in 1850; that of Dana in 1852; that of Heller in 1863; that of Claus in 1880; and that of Huxley in 1883.

The scheme of grouping followed in this paper regarding the Macrura is that of Spence Bate, which is a modification of those adopted by other authors. He proposed to divide Macrura into divisions, as follows:

Suborder MACRURA

Trichobranchiata—Dendrobranchiata—Phyllobranchiata—Anomobranchiata

The Trichobranchiata have the branchial plumes made up of long cylindrical filaments. The Phyllobranchiata have the

[1] Philip. Journ. Sci. 56 (1935) 1.

plumes formed by a series of foliaceous plates. The Tricho-branchiata may be divided into two groups: (1) the Normalia, which have the most typical conditions, and (2) the Aberrantia, which depart more or less from the typical arrangement of the branchiæ as well as in the plan of the external structure and development.

The ovum as in Phyllobranchiata when extruded from the oviduct is attached to the pleopoda by a filamentous attachment and hatches either in the zœa, phyllosoma, or the megalopa stage.

The Dendrobranchiata differ from the other two divisions in anatomical structure, external form, development, and general habits, and may likewise be divided into a normal and an aberrant group. The branchial structure consists of series of plumes attached by, or very near, their basal extremity to the animal and from a long central stalk send off on each side a single row of branches that divide and subdivide in a more or less distinctly different manner in separate genera, and sometimes also in otherwise well-defined species. In the Dendrobranchiata the form of the brephalos is unknown. It is supposed to be that of a nauplius in the Penæidæ.

In the Phyllobranchiata the branchial plumes, which are in the form of broad foliaceous plates, are attached to a central stalk. The aberrant group of this division has long been distinguished by carcinologists under Anomura, but sometimes as a division of Macrura.[2]

[2] Challenger Report, Zool. 24 (1873–76).

Order DECAPODA

Suborder MACRURA

Division PHYLLOBRANCHIATA [3]

Group	Tribe.	Family.	Genera.	Brephalos.
Group NORMALIA	**Crangonidea**	**Crangonidæ**	Crangon	Zœa
			Pontophilus	
			Sabinea	
			Pontocaris	
	Polycarpidea	**Processidæ** (= Nikidæ)	Glyphocrangon	Megalopa
			Nika (= Processa)	
		Alpheidæ	**Athanas**	
			Parathanas	
			Cheirothrix	
			Alpheus	Zœa or Megalopa
			Betæus	
			Paralpheus	
			Ogyris	
			Synalpheus	
		Hippolytidæ	Platybema	
			Latreutes	
			Hippolyte	Zœa
			Spirontocaris	
			Nauticaris	
			Hetairus	
			Chorismus	
			Merhippolyte	
			Amphiplectus	
		Pandalidæ	**Heterocarpus**	
			Plesionika	
			Nothocaris	
			Pandalus	
			Pandalopsis	
			Chlorotocus	
			Dorodotes	
	Monocarpidea	**Thalassocaridæ**	**Thalassocaris**	
			Diaphoropus	
			Kyptocaris	
		Atyidæ	**Atya**	Zœa
			Caridina	
			Ortmannia	
		Pontoniidæ	Pontonia	
			(Typton)	
		Caricyphidæ	**Caricyphus**	
			Rhomaleocaris	
			Anebocaris	

[3] The scheme of groupings adopted is that of Spence Bate in Challenger Report Vol. 24. The families and genera in boldface are represented in the Philippines.

Group	Tribe.	Family.	Genera.	Brephalos.
Group NORMALIA	Monocarpidea	**Acanthephyridæ**	Bentheocaris	
			Acanthephyra	
			Systellospis	
			Oplophorus	
			Campilonotus	
		Palæmonidæ	**Palæmon**	Zœa
			Palæmonella	
			Bithynis	
			Brachycarpus	
		Nematocarcinidæ	**Nematocarcinus**	
			Stochasmus	
		Tropiocaridæ	**Notostomus**	
			Tropiocaris	
			Hymenodora	**Megalopa**
		Stylodactylidæ	**Stylodactylus**	
		Pasiphæidæ	**Leptochela**	
			Pasiphæa	
			Orphania	
		Oödeopidæ	**Oödeopus**	
	Haplopodea	**Hectarthropidæ**	Procletes	
			Icotopus	
			Hectarthropus	
			Eretmocaris	
			Amphion	
Group ABERRANTIA			**Sestertius**	
			Zoöntocaris	

Division DENDROBRANCHIATA

Group	Tribe.	Family.		Genera.	Brephalos.
Group NORMALIA	**Penæidea**	**Penæidæ** [a]		**Penæus**, Philonicus, **Artemesia**, **Haliporus**, Sicyonia, **Hemipenæus**, **Aristeus**, Hepomalus, Peteinura, **Benthesicymus**, **Gennadas**	Nauplius
		Sergestidæ	**Sergestinæ**	Petalidium, Sergestes, Sciacarus, Acanthosoma, Acetes	?Elaphocaris
			Luciferinæ	**Lucifer**	
Group ABERRANTIA	**Schizopoda**	Euphausidæ			Nauplius
		Lophogastridæ			Nauplius
		Eucopidæ		Eucopia	Nauplius
		Mysidæ			Metanauplius

[a] The branchiæ are well developed in the Penæidæ. They diminish in number and importance in the Sergestinæ and disappear in Lucifer.

Division TRICHOBRANCHIATA

Group	Tribe.	Family.	Genera.	Brephalos.
Group NORMALIA	Synaxidea	**Scyllaridæ**	**Ibaccus**, Paribaccus, Pseudobaccus, **Thenus**, **Scyllarus**, **Arctus**	**Phyllosoma**
		Palinuridæ	**Linuparis**, **Panulirus**, Palinurus, Palinostus, Synaxes	**Phyllosoma**
	Astacidea	**Eryonidæ**	Eryon, Eryoneicus, Eryonasticus, Polycheles, **Pentacheles**, Stereomastis, Willemaesia	

Group	Tribe.	Family.	Genera.	Brephalos.
Group NORMALIA	Astacidea	**Homaridæ**	Phoberus	
			Nephropsis	
			Nephrops	
			Homarus	
		Astacidæ	Cambarus	
			Astacus	
			Astacoides	
			Parastacus	
			Paranephrops	
			Astacopsis	
			Engarus	
			Cherops	
	Stenopidea	**Stenopidæ**	**Stenopus**	Zœa
			Spongicola	
Group ABERRANTIA		**Galatheidæ**	**Galathea**	Zœa
			Munida	
			Æglea	
			Grimothea	
			Uroptychus	
			Munidopsis	
			Elasmonotus	
		Pylochelidæ	Cheiroplatea	Zœa
			Pomatocheles	
			Pylocheles	
		Thalassinidæ	**Thalassina**	
		Callianassiidæ	**Callianassa**	
			Cheramus	
			Scallasis	
			Tripsea	
			Calliadina	
			Gebia	
		Axiidæ	**Axius**	Megalopa
			Axiopsis	
			Paraxius	
			Scytoleptus	
			Eiconaxius	
		Thamastochelidæ	Thamastocheles	
			Calliaxus	
			Calocaris	

A CHECK LIST OF PHILIPPINE CRUSTACEAN DECAPODS

A synoptic table of Philippine genera.

Suborder Macrura
- Division Phyllobranchiata
  - Group Normalia
    - Tribe Crangonidea
      - Family Crangonidæ
        - *Pontophilus*
    - Tribe Polycarpidea
      - Family Processidæ (= Nikidæ)
        - *Processa* (= *Nika*)
      - Family Alpheidæ
        - *Alpheus*
        - *Parathanas*
        - *Ogyris*
        - *Synalpheus*
      - Family Hippolytidæ
        - *Latreutes*
      - Family Pandalidæ
        - *Dorodotes*
        - *Nothocaris*
        - *Heterocarpus*
        - *Plesionika*
    - Tribe Monocarpidea
      - Family Thalassocaridæ
        - *Kyptocaris*
        - *Thalassocaris*
      - Family Atyidæ
        - *Atya*
        - *Ortmannia*
        - *Caridina*
      - Family Caricyphidæ
        - *Anebocaris*
        - *Caricyphus*
      - Family Acanthephyridæ
        - *Acanthephyra*
        - *Oplophorus*
      - Family Palæmonidæ
        - *Palæmon*
        - *Palæmonella*
      - Family Nematocarcinidæ
        - *Nematocarcinus*
      - Family Tropiocaridæ
        - *Notostomus*
        - *Hymenodora*

Suborder Macrura—Continued
  Division Phyllobranchiata—Continued
    Group Normalia—Continued
      Tribe Monocarpidea—Continued
        Family Stylodactylidæ
          Stylodactylus
        Family Pasiphæidæ
          Pasiphæa
          Leptochela
        Family Oödeopidæ
          Oödeopus
      Tribe Haplopodea
        Family Hectarthropidæ
          Hectarthropus
    Group Aberrantia
          Sestertius
          Zoöntocaris
  Division Dendrobranchiata
    Group Normalia
      Tribe Penæidea
        Family Penæidæ
          Penæus
          Hemipenæus
          Benthesicymus
          Haliporus
          Aristeus
          Gennadas
        Family Sergestidæ
          Lucifer
          Sergestes
          Acanthosoma
  Division Trichobranchiata
    Group Normalia
      Tribe Syncaridea
        Family Scyllaridæ
          Ibaccus
          Scyllarus
          Arctus
          Thenus
        Family Palinuridæ
          Palinurus
      Tribe Astacidea
        Family Eryonidæ
          Pentacheles
        Family Homaridæ
          Nephrops
      Tribe Stenopidea
        Family Stenopidæ
          Stenopus
          Spongicola

Suborder Macrura—Continued
- Division Trichobranchiata—Continued
  - Group Aberrantia
    - Family Galatheidæ
      - *Galathea*
      - *Munidopsis*
      - *Uroptychus*
      - *Munida*
      - *Elasmonotus*
    - Family Thalassinidæ
      - *Thalassina*
    - Family Callianassiidæ
      - *Callianassa*
      - *Gebia*
    - Family Axiidæ
      - *Axius*
      - *Scytoleptus*
      - *Axiopsis*

Suborder Anomura
- Tribe Paguridea
  - Family Paguridæ
    - *Clibanarius*
    - *Aniculus*
    - *Calcinus*
    - *Paguristes*
    - *Pagurus*
    - *Diogenes*
    - *Eupagurus*
    - *Spiropagurus*
  - Family Cœnobitidæ
    - *Birgus*
    - *Cœnobita*
  - Family Parapaguridæ
    - *Pagurodes*
    - *Parapagurus*
    - *Paguropsis*
- Tribe Porcellanidea
  - Family Porcellanidæ
    - *Petrolisthes*
    - *Pisisoma*
- Tribe Hippidea
  - Family Hippidæ
    - *Remipes*
    - *Mastigochirus*
  - Family Albuneidæ
    - *Albunea*

Suborder Brachyura
- Tribe Homolidea
  - Family Latreillidæ
    - *Latreillopsis*
    - *Latreilla*

Suborder Brachyura—Continued

Tribe Dromidea

Family Dromidæ

Dromia
Cryptodromia

Tribe Oxystomata

Family Raninidæ

Ranina

Family Leucosidæ

Leucosia
Pseudophilyra
Myra
Ixa
Arcania
Oreophorus
Philyra
Cryptocnemus
Myrodes
Iphiculus
Heterolithadia
Oreophorus

Family Dorippidæ

Dorippe
Ethusa

Family Calappidæ

Calappa

Family Matutidæ

Matuta

Tribe Cyclometopa

Family Corystidæ

Gomeza

Family Portunidæ

Charybdis
Thalamitoides
Scylla
Podophthalmus
Thalamita
Neptunus
Lissocarcinus

Family Xanthidæ

Carpilius
Carpilodes
Lophactea
Atergatopsis
Xantho
Etisus
Actæa
Chlorodopsis
Xanthodes
Epixanthus

Suborder Brachyura—Continued
Tribe Cyclometopa—Continued
Family Xanthidæ—Continued
Pilumnus
Trapezia
Liomera
Lophozozymus
Lophopanopeus
Atergatis
Leptodius
Etisodes
Chlorodius
Phymodius
Menippe
Baptozius
Eriphia
Quadrella
Family Potamonidæ
Potamon
Pseudotelphusa
Tribe Catometopa
Family Goneplacidæ
Carcinoplax
Goneplax
Typhlocarcinus
Chasmocarcinus
Psopheticus
Ceratoplax
Hephthopelta
Typhlocarcinops
Family Grapsidæ
Grapsus
Geograpsus
Metasesarma
Varuna
Ptychognathus
Percnon
Metopograpsus
Sesarma
Helice
Utica
Plagusia
Family Geocarcinidæ
Cardisoma
Gecarcinus
Gecarcoidea
Family Ocypodidæ
Ocypode
Macrophthalmus

Suborder Brachyura—Continued
Tribe Catometopa—Continued
Family Ocypodidæ—Continued
Uca
Tympanomerus
Family Pinnotheridæ
Pinnotheres
Xenophthalmus
Xanthusia
Family Myctiridæ
Myctiris
Family Palicidæ
Palicus
Tribe Oxyrhyncha
Family Inachidæ
Achæus
Camposcia
Echinoplax
Platymaia
Achæopsis
Menæthius
Huenia
Sphenocarcinus
Oncinopus
Inachus
Anamathia
Cyrtomaia
Oxypleurodon
Peltinia
Pugettia
Doclea
Family Maiidæ
Hyastenus
Naxioides
Pisa
Naxia
Maia
Schizophrys
Chorilia
Phalangipus
Egeria
Micippa
Leptomithrax
Paramithrax
Family Periceridæ
Pericera
Mithrax
Tiarinia

Suborder Brachyura—Continued
Tribe Oxyrhyncha—Continued
Family Parthenopidæ
Parthenope
Daldorfia
Cryptopodia
Lambrus
Family Eumedomidæ
Ceratocarcinus
Zebrida
Harrovia

Order DECAPODA

Suborder MACRURA

Division PHYLLOBRANCHIATA

Group NORMALIA

Tribe CRANGONIDEA

CRANGONIDÆ

Genus PONTOPHILUS Leach

PONTOPHILUS GRACILIS Spence Bate.

Pontophilus gracilis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 489, pl. 87.

Near the Philippines; 2,150 fathoms; blue mud bottom (Challenger).

PONTOPHILUS JUNCEUS Spence Bate.

Pontophilus junceus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 491, pl. 88, figs. 2–4; BALSS, Macrura, Deutsch. Tiefsee Exped. **2** (1925) 296.

Between Philippines and Borneo, 250 fathoms; green mud bottom (Challenger).

PONTOPHILUS JAPONICUS Doflein.

Pontophilus japonicus DE MAN, Decapoda, Siboga Exped. pt. IV **87** (1917) 286, pls. 23, 24, figs. 69–69*j*.

Sulu Sea, 150 to 285 fathoms, coral and stony bottom (Siboga).

PONTOPHILUS CHALLENGERI Ortmann.

Pontophilus challengeri DE MAN, Decapoda, Siboga Exped. pt. IV **87** (1917) 252.

Near the Philippines, 2,150 fathoms (Siboga).

Tribe POLYCARPIDEA

Family PROCESSIDÆ Ortmann

Genus PROCESSA

PROCESSA AUSTRALIENSIS Baker.

Processa australiensis BAKER, Notes on South Austral. Decapoda, Crust. pt. V, Trans. Royal Soc. South Austral. **31** (1907) **185**, pl. **25**, figs. 2–2*c*; DE MAN, Decapod. Siboga Exped. pt. IV **87** (1917) 199–203.

Sulu Archipelago, from a reef (Siboga).

PROCESSA sp.

Processa sp. DE MAN, Decapod. Siboga Exped. pt. IV **87** (1917) **203**.

Sulu, Sulu harbor, 7 to 8 fathoms; sand bottom. (Siboga).

ALPHEIDÆ

Genus ALPHEUS Fabricius

ALPHEUS SPINIGER Stimpson.

Alpheus spiniger STIMPSON, Proc. Acad. Nat. Sci. Philad. (1860) **110**; SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) **560**, pl. **100**.

Off Manila, 18 fathoms, blue mud bottom (Challenger).

ALPHEUS CRINITUS Dana.

Alpheus crinitus DANA, U. S. Explor. Exped. Crust. (1852) **548**, pl. 34, fig. 8*a–f*; SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 548, pl. 98, fig. 2; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 357.

Off Zamboanga, on a reef, 18 fathoms; Balabac Passage (Dana).

ALPHEUS BIUNGUICULATUS Stimpson.

Alpheus biunguiculatus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1860) 100; SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) **562**, pl. 101, fig. 4.

Off Manila, 18 fathoms; blue mud bottom (Challenger).

ALPHEUS EDWARDSII var. LEVIUSCULUS Dana.

Alpheus edwardsii var. *leviusculus* DANA, U. S. Explor. Exped. Crust. (1852) 543, pl. 34, fig. 3; SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 549, pl. 98, fig. 1.

Off Panay, 20 fathoms, blue mud bottom (Challenger).

ALPHEUS ACUTO-FEMORATUS Dana.

Alpheus acuto-femoratus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 540.

Balabac Passage (Dana).

ALPHEUS NEPTUNUS Dana.

Alpheus neptunus DANA, U. S. Explor. Exped. Crust. 1 (1852) 553, pl. 35, fig. 5; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 563, pl. 101.

Sulu Sea; 6 to 9 fathoms (Challenger).

ALPHEUS MITIS Dana.

Alpheus mitis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 540.

Balabac Passage, 1 fathom (Challenger).

ALPHEUS PARVIROSTRIS Dana.

Alpheus parvirostris DANA, U. S. Explor. Exped. Crust. (1852) 551, pl. 35, fig. 3; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 541; DE MAN, Decapoda Siboga Exped. pt. II 60 (1911) 432.

Alpheus lineifer MIERS, Ann. Mag. Nat. Hist. (4) 16 (1875) 343.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, from a reef (Siboga).

ALPHEUS COLLUMIANUS Stimpson.

Alpheus collumianus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1860) 30; DE MAN, Decapoda, Siboga Exped. pt. II 60 (1911) 334.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, 12 m, sand and coral bottom (Siboga).

ALPHEUS MALLEODIGITUS (Spence Bate).

Betæus malleodigitus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 565, pl. 101, fig. 5.

Alpheus malleodigitus DE MAN, Decapoda, Siboga Exped. pt. II 60 (1911) 347.

Southeast side of Pearl Bank, Sulu Archipelago; 15 m, lithothamnion bottom (Siboga).

ALPHEUS MALLEODIGITUS var. GRACILICARPUS de Man.

Alpheus malleodigitus var. *gracilicarpus* DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 349.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, 12 m, lithothamnion bottom (Siboga).

ALPHEUS CONSOBRINUS de Man.

Alpheus consobrinus DE MAN, Notes Leyden Mus. 30 (1908) 101; DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 560.

Southeast side of Pearl Bank, Sulu Archipelago (Siboga).

ALPHEUS FRONTALIS H. M. Edwards.

Alpheus frontalis H. M. EDWARDS, Hist. Nat. Crust. 2 (1837) 356; DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 369.

Alpheus latifrons A. M. EDWARDS, Journ. des Mus. Godeffroy (1874) 11; DE MAN, Archiv. f. Naturg. 53 Jahrg. (1888) 521, pl. 32.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, from a reef (Siboga).

ALPHEUS COUTIERI de Man.

Alpheus coutieri DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 409.

Southeast side of Pearl Bank, Sulu Archipelago; 15 m, lithothamnion bottom (Siboga).

ALPHEUS PAREUCHIRUS Coutiere.

Alpheus pareuchirus COUTIERE, Alpheidae, Maldive and Laccadive Archipelago (1905) 906, pl. 84, fig. 43; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 418.

Off Pulu Tongkil, Sulu Archipelago, 13 m, lithothamnion bottom (Siboga).

ALPHEUS PAREUCHIRUS var. LEUCOTHEA de Man.

Alpheus pareuchirus var. *leucothea* DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 420.

Off Pulu Tongkil, Sulu Archipelago, 13 m, lithothamnion bottom (Siboga).

ALPHEUS STRENUUS Dana.

Alpheus strenuus DANA, U. S. Explor. Exped. Crust. (1852) 543, pl. 34, fig. 4; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 425.

Alpheus labidens LANCHESTER, Proc. Zool. Soc. London (1900) 563.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, from a reef (Siboga).

ALPHEUS PACIFICUS Dana.

Alpheus pacificus DANA, U. S. Explor. Exped. Crust. (1852) 544, pl. 34, fig. 5; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 427.

Alpheus gracilidigitus MIERS, Rept. Voy. H. M. S. "Alert" (1884) 287.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, from a reef (Siboga).

ALPHEUS HIPPOTHOË de Man.

Alpheus hippothoë DE MAN, Journ. Linn. Soc. London **22** (1888) 268, pl. 17, figs. 1–5; HENDERSON, Trans. Linn. Soc. Zoöl. II **5** (1893) 436; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 433.

Sulu, Sulu harbor, 14 m, sandy bottom (Siboga).

ALPHEUS ALCYONE de Man (charact. emend.).

Alpheus alcyone DE MAN, Abhandl. Senckenberg. Naturf. Gesell. **25** (1902) 870, pl. 27, fig. 61; NOBILI, Bul. Sci. France et Belgique **40** (1906) 32; DE MAN, Decapod. Siboga Exped. pt. 2 **60** (1911) 351.

Alpheus aculeipes COUTIERE, Alpheidae, Maldive and Laccadive Archipelago (1905) 892.

Sulu Archipelago, off north Ubian, 16 m, lithothamnion bottom (Siboga).

ALPHEUS PARALCYONE Coutiere.

Alpheus paralcyone COUTIERE, Alpheidae, Maldive and Laccadive Archipelago (1905) 895, pls. 80, 81, fig. 34; DE MAN, Decapod. Siboga Exped. pt. II **60** (1911) 354.

Sulu Archipelago, off north Ubian, 16 m, lithothamnion bank (Siboga).

ALPHEUS BICOSTATUS de Man.

Alpheus bicostatus DE MAN, Notes Leyden Mus. 30 (1908) 102; Decapoda, Siboga Exped. pt. II 60 (1911) 375.

Sulu Archipelago, off north Ubian, 16 m, lithothamnion bank (Siboga).

ALPHEUS MIERSI Coutiere.

Alpheus rapax var. *miersi* COUTIERE, Bul. Soc. Entom. France (1898) 166.

Alpheus miersi COUTIERE, Alpheidae, Maldive and Laccadive Archipelago (1905) 903, pls. 83, 84, fig. 42; DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 393.

Sulu Archipelago, off north Ubian, 16 m, lithothamnion bank (Siboga).

ALPHEUS PACHYCHIRUS Stimpson.

Alpheus pachychirus STIMPSON, Proc. Acad. Nat. Philad. (1860) 30; DE MAN, Decapod. Siboga Exped. pt. 2 60 (1911) 366; H. A. ROXAS, Rept. Puerto Galera Marine Biol. Lab. List of Anim. (1930) 16.

MINDORO, Mindoro, Puerto Galera, 0–427.

Genus SYNALPHEUS Spence Bate

SYNALPHEUS NEOMERIS (de Man).

Alpheus neomeris DE MAN, Zoöl. Jahrb. Abth. Syst. 9 (1897) 734.

Synalpheus neomeris NOBILI, Bul. Sci. France et Belgique 40 (1906) 25; DE MAN, Decapod. Siboga Exped. pt. 2 60 (1911) 212.

Sulu Archipelago, Southeast side of Pearl Bank, 15 m, lithothamnion bottom (Siboga).

SYNALPHEUS FOSSOR var. PROPINQUA de Man.

Synalpheus fossor var. *propinqua* DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 250.

Sulu Archipelago, southeast side of Pearl Bank, 15 m, lithothamnion bottom (Siboga).

SYNALPHEUS CARINATUS var. UBIANENSIS de Man.

Synalpheus carinatus var. *ubianensis* DE MAN, Decapod. Siboga Exped. pt. II 60 (1911) 212.

Sulu Archipelago, off north Ubian, 16 m, lithothamnion bottom (Siboga).

SYNALPHEUS PESCADORENSIS Coutiere.

Synalpheus pescadorensis COUTIERE, Alpheidae, Maldive and Laccadive Archipelago (1905) 877, pl. 73, fig. 15; DE MAN, Decapoda, Siboga Exped. pt. II 60 (1911).

Southeast side of Pearl Bank, Sulu Archipelago, 15 m, lithothamnion bottom (Siboga).

Genus OGYRIS Stimpson

OGYRIS SIBOGÆ de Man.

Ogyris sibogæ DE MAN, Tijdschr. d. Ned. Vereen (2) 11 (1910) 318; Decapod. Siboga Exped. pt. II 60 (1911) 3.

Sulu Sea; 500 m, fine yellow sand bottom (Siboga).

Genus PARATHANAS Spence Bate

PARATHANAS IMMATURUS Spence Bate.

Parathanas immaturus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 532.

Cebu, Cebu Harbor, from plankton (Challenger).

PARATHANAS DECORTICUS Spence Bate.

Parathanas decorticus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 530, pl. 89, fig. 3.

Off Sibago, Zamboanga, 80 fathoms (Challenger).

HIPPOLYTIDÆ

Genus LATREUTES Stimpson

LATREUTES PLANUS Spence Bate.

Latreutes planus SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 584, pl. 89, fig. 5.

Off Sibago, Zamboanga Province.

LATREUTES UNIDENTATUS Spence Bate.

Latreutes unidentatus SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 586, pl. 89, fig. 6.

Off Sibago, Zamboanga Province.

Family PANDALIDÆ Spence Bate

Genus HETEROCARPUS A. M. Edwards

HETEROCARPUS GIBBOSUS Spence Bate.

Heterocarpus gibbosus SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 634, pl. 112, fig. 2; DE MAN, Decapoda Siboga Exped. pt. II **87** (1920) 163, pl. 14, fig. 39; BALSS, Macrura, Deutsch. Tiefsee Exped. 2 (1925) 287.

Off Tablas, 700 fathoms, blue mud bottom (Challenger).

HETEROCARPUS ALPHONSI Spence Bate.

Heterocarpus alphonsi SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 632, pl. 112, fig. 1.

South of the Philippines, 500 fathoms, blue mud bottom.

HETEROCARPUS ENSIFER A. M. Edwards.

Heterocarpus ensifer A. M. EDWARDS, Ann. Sci. Nat. VI Art. 4 **11** (1861) 8; SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 638, pl. 112, fig. 4.

Pandalus carinatus SIDNEY SMITH, Bull. Mus. Comp. Zoöl. **10** (1882) 63, pl. 10, figs. 2–2 f, pl. 11, figs. 1–3.

Between the Philippines and Borneo, 250 fathoms, green mud bottom (Challenger).

HETEROCARPUS ENSIFER var. PARVISPINA de Man.

Heterocarpus ensifer var. *parvispina* DE MAN, Decapoda, Siboga Exped. **87** (1920) 167.

North of Sulu, 150 fathoms.

Genus DORODOTES Spence Bate

DORODOTES REFLEXUS Spence Bate.

Dorodotes reflexus SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 678, pl. 116, fig. 3; ALCOCK, Descript. Cat. Indian Deep Sea Crust. Calcutta (1901) 109; DE MAN, Decapoda, Siboga Exped. **87** (1920) 152.

Off LUZON, 1,050 fathoms, blue mud bottom (Challenger).

Genus PLESIONIKA Spence Bate

PLESIONIKA BREVIROSTRIS Spence Bate.

Plesionika brevirostris SPENCE BATE, Rept. Voy. Challenger, Zoöl. **24** (1873–76) 650, pl. 113, fig. 5.

Between the Philippines and Borneo, 250 fathoms, green mud bottom.

PLESIONIKA SEMILÆVIS Spence Bate.

Plesionika semilævis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 644, pl. 113, fig. 3.

Plesionika martia var. *semilævis* DE MAN, Decapoda, Siboga Exped. **87** (1920) 116, pl. 10, figs. 24–24*b*.

Plesionika martia BALSS, Macrura, Deutsch. Tiefsee Exped. **2** (1925) 278.

Between the Philippines and Borneo, 250 fathoms, green mud bottom. The Siboga specimen was collected from Sulu Sea, 450 fathoms, dead coral bottom (Challenger).

PLESIONIKA SINDOI (Rathbun).

Pandalus sindoi RATHBUN, U. S. Fish Comm. Bull. for 1903 (1906) 915, pl. 21, fig. 4.

Plesionika sindoi DE MAN, Decapoda, Siboga Exped. pt. IV **87** (1920) 126, pls. 11, 12, figs. 27–27*e*.

Sulu Sea, 150 fathoms, stony bottom (Siboga).

Genus NOTHOCARIS Spence Bate

NOTHOCARIS OCELLUS Spence Bate.

Nothocaris ocellus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 657, pl. 114, fig. 3.

Near Zamboanga, 82 fathoms, stone and gravel bottom.

Tribe MONOCARPIDEA

THALASSOCARIDÆ

Genus KYPTOCARIS Spence Bate

KYPTOCARIS STYLOFRONTALIS Spence Bate.

Kyptocaris stylofrontalis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 690, pl. 121, fig. 1.

Off SIBAGO, Zamboanga Province; from the surface.

Genus THALASSOCARIS Stimpson

THALASSOCARIS CRINITA (Dana).

Regulus crinitus DANA, U. S. Explor. Exped. Crust. (1852) 599, pl. 39, fig. 6*a–h*.

Thalassocaris crinitus BALSS, Ostasiatische Decapoden II, München (1914) 28.

Thalassocaris crinita DE MAN, Decapoda, Siboga Exped. 87 (1920) 95, pl. 9, figs. 22–22*o*.

Sulu Archipelago, Tawitawi Island, Pulu Sanguisiapo, sand and coral bottom (Siboga).

ATYIDÆ

Genus ATYA Leach

ATYA MOLUCCENSIS de Haan.

Atya moluccensis DE HAAN, Fauna Japon. Crust. (1849) 184, pl. 21.

Atya armata MILNE EDWARDS, Ann. Soc. Ent. de France (1864) 149, pl. 3, fig. 3.

Atya gustavi ORTMANN, Zool. Jahrb. Syst. 5 (1890) 467, pl. 36, figs. *a–c*.

LUZON, Bataan Province, Mariveles, 0–1372. MINDORO, Malayas River, 0270.

ATYA SERRATA Spence Bate.

Atyoida tahitensis STIMPSON, Proc. Acad. Nat. Sci. Philad. (1860) 97.

Atya serrata SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 669, pl. 119, fig. 2; ORTMANN, Proc. Acad. Nat. Sci. Philad. (1895) 410; BLANCO, Philip. Journ. Sci. 56 (1935) 31, pl. 1, figs. 1–4.

Atya brevirostris DE MAN, Zool. Ergeb. (1892) 360, pl. 21, fig. 21.

MINDORO, Malayas River, 0271. LUZON, Ilocos Norte, Laoag River.

Genus CARIDINA Milne Edwards

CARIDINA GRACILLIMA Lanchester.

Caridina gracillima LANCHESTER, Proc. Zool. Soc. London (1901) 560, pl. 34, fig. 1; BLANCO, Philip. Journ. Sci. 56 (1935) 32, pl. 1, figs. 5–10.

LUZON, Ilocos Norte Province, Laoag, Caaoacan River.

CARIDINA GRACILIROSTRIS de Man.

Caridina gracilirostris DE MAN, Zool. Ergeb. (1892) 399, pl. 25, fig. 31; NOBILI, Ann. Mus. Civ. St. Nat. Genova II 20 (1900) 477; BLANCO, Philip. Journ. Sci. 56 (1935) 32, pl. 2, figs. 11–17.

LUZON, Laguna Bay. Specimen in the Bureau of Science.

CARIDINA NILOTICA var. BRACHYDACTYLA de Man.

Caridina nilotica var. *brachydactyla* DE MAN, Rec. Ind. Mus. 2 (1908) 269, pl. 20, fig. 8; BLANCO, Philip. Journ. Sci. 56 (1935) 33, pl. 2, fig. 18.

Caridina brachydactyla subsp. *peninsularis* KEMP, Mem. Asiat. Soc. Bengal 6 (1918) 270, fig. 10.

LUZON, Ilocos Norte Province, Laoag, Caaoacan River. Specimen in the Bureau of Science.

CARIDINA MODIGLIANI Nobili.

Caridina modigliani NOBILI, Ann. Mus. Civ. Stor. Nat. Genova 20 (1900) 477; BOUVIER, Bul. Scient. de Fr. et Belg. 39 (1905) 72; BLANCO, Philip. Journ. Sci. 56 (1935) 34, pl. 2, figs. 19–24.

LUZON, Ilocos Norte Province, Laoag River. Specimen in the Bureau of Science.

CARIDINA BREVICARPALIS var. ENDEHENSIS de Man.

Caridina brevicarpalis var. *endehensis* DE MAN, Zool. Niederlandisch Ost. Indien (1892) 399, pl. 24, figs. 30*c–e;* BLANCO, Philip. Journ. Sci. 56 (1935) 34, pl. 2, fig. 25.

LUZON, Batangas Province, Pancipit River. Specimen in the Bureau of Science.

CARIDINA LÆVIS Heller.

Caridina lævis HELLER, Verh. Zool. Bot. Ges. Wien 12 (1862) 411; DE MAN, Zool. Ergeb. (1892) 376, pl. 22, fig. 27; BOUVIER, Trans. Linn. Soc. London II 15 (1913) 464; BLANCO, Philip. Journ. Sci. 56 (1935) 34, pl. 2, figs. 26–32.

LUZON, Albay Province, Pulangue Lake. Specimen in the Bureau of Science.

Genus ORTMANNIA Rathbun

ORTMANNIA sp.

Ortmannia sp. BLANCO, Philip. Journ. Sci. 56 (1935) 36, pl. 3, figs. 33–40.

LUZON, Ilocos Norte Province, Caaoacan River. Specimen in the Bureau of Science.

CARICYPHIDÆ

Genus CARICYPHUS Spence Bate

CARICYPHUS TURGIDUS Spence Bate.

Caricyphus turgidus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 717, pl. 121, fig. 5.

China Sea, off LUZON, on surface.

CARICYPHUS CORNUTUS Spence Bate.

Caricyphus cornutus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 712, pl. 121, fig. 2.

Philippines, near Zamboanga Province, on surface.

Genus ANEBOCARIS Spence Bate

ANEBOCARIS QUADROCULUS Spence Bate.

Anebocaris quadroculus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 722, pl. 123, fig. 1.

CEBU, Cebu harbor; Basilan Strait.

Family ACANTHEPHYRIDÆ Spence Bate

(=Hoploridæ de Man)

Genus ACANTHEPHYRA A. M. Edwards

ACANTHEPHYRA LONGIDENS Spence Bate.

Acanthephyra longidens SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 375, pl. 124, fig. 4.

Near the Philippines, 2,150 fathoms; blue mud bottom (Challenger). This species is regarded as identical with *A. microphthalma* S. I. Smith 1885.[4]

ACANTHEPHYRA MEDIA Spence Bate.

Acanthephyra media SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 736, pl. 124, fig. 5; DE MAN, Decapoda, Siboga Exped. 87 (1920) 45.

Off Tablas, 700 fathoms, blue mud bottom (Challenger).

ACANTHEPHYRA ACUTIFRONS Spence Bate.

Acanthephyra acutifrons SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 749, pl. 126, fig. 3; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 261.

South of the Philippines, 500 fathoms, blue mud bottom (Challenger).

ACANTHEPHYRA BRACHYTELSONIS Spence Bate.

Acanthephyra brachytelsonis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 753, pl. 126, fig. 7; WOOD-MASON and A. ALCOCK, Ann. Mag. Nat. Hist. VI 9 (1892) 362.

Acanthephyra eximia var. *brachytelsonis* DE MAN, Decapoda, Siboga Exped. 87 (1920) 55.

South of the Philippines, 500 fathoms, blue mud bottom (Challenger).

ACANTHEPHYRA ROSTRATA (Spence Bate).

Acanthephyra rostrata DE MAN, Decapoda, Siboga Exped. 87 (1920) 45.

Philippines, 1,050 fathoms (Siboga).

Genus OPLOPHORUS M. Edwards

(=*Hoplophorus* H. M. Edwards)

OPLOPHORUS BREVIROSTRIS Spence Bate.

Oplophorus brevirostris SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 766, pl. 127, fig. 3.

Hoplophorus typus BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 248.

Off Tablas, 700 fathoms, blue mud bottom (Challenger).

[4] Siboga 87 (1920) 45.

Family PALÆMONIDÆ Spence Bate

Genus PALÆMON Fabricius

PALÆMON LANCEIFRONS Dana.

Palæmon lanceifrons DANA, U. S. Explor. Exped. Crust. (1852) 589, pl. 38, fig. 13; COWLES, Philip. Journ. Sci. 9 (1914) 364–371, pl. 2, figs. 4, 4*a*.

LUZON, Manila market, San Juan River, 0–54.

PALÆMON LANCEIFRONS var. MONTALBANENSIS Cowles.

Palæmon lanceifrons var. *montalbanensis* COWLES, Philip. Journ. Sci. 9 (1914) 371–379, pl. 2, figs. 6, 6*a–i*.

LUZON, Rizal Province, Montalban River.

PALÆMON LAR Fabricius.

Palæmon lar FABRICIUS, Suppl. Entom. Syst. p. 402; OLIVIER, Encyclop. 8 : 659; MILNE EDWARDS, Hist. Nat. Crust. 2 : 397; COWLES, Philip. Journ. Sci. 9 (1914) 371–379, pl. 2, figs. 7, 7*a–h*.

Bithynis lar SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 789, pl. 129, fig. 1.

MINDORO, Mindoro Province, Puerto Galera, 0–79. LUZON, Bataan Province, Mariveles, 0–1542; Rizal Province, San Juan del Monte, 0–1554.

PALÆMON JAROENSIS Cowles.

Palæmon jaroensis COWLES, Philip. Journ. Sci. 9 (1914) 385–389, pl. 3, figs. 8, 8*a–k*.

LEYTE, Jaro, 0–1556.

PALÆMON LEPIDACTYLUS Hilgendorf.

Palæmon lepidactylus COWLES, Philip. Journ. Sci. 9 (1914) 389–392, pl. 3, figs. 9, 9*a–b*.

LUZON, Bataan Province, Sisiman, Tictic, 0–417.

PALÆMON LATIDACTYLUS Thallwitz.

Palæmon latidactylus COWLES, Philip. Journ. Sci. 9 (1914) 392–397, pl. 3, figs. 10, 10*a–b*.

SAMAR, Gandara, 0–71. LUZON, Bataan Province, Mariveles, 0–1543; LEYTE, Jaro, 0–1500; MINDANAO, Agusan, 0–1451.

PALÆMON CARCINUS Fabricius.

Palæmon carcinus FABRICIUS, Suppl. Entom. p. 402; DE MAN, Journ. Linn. Soc. London 20 (1888) 280; COWLES, Philip. Journ. Sci. 9 (1914) 334–340, pl. 1, figs. 1, 1*a–j*.

LUZON, Rizal Province, San Juan River, 0–70. MINDORO, Lake Naujan, 0–1647.

PALÆMON PHILIPPINENSIS Cowles.

Palæmon philippinensis COWLES, Philip. Journ. Sci. 9 (1914) 340–355, pl. 2, figs. 2, 2*a–m*.

LUZON, Rizal Province, San Juan River, 0–108.

PALÆMON SUNDAICUS Heller.

Palæmon sundaicus HELLER, Sitz.-Ber. Akad. Wiss. Wien 45 (1862) 415, pl. 2, figs. 38, 39; COWLES, Philip. Journ. Sci. 9 (1914) 355–364 pl. 2, figs. 3, *3a–f*.

Quite abundant in Laguna Bay. Commonly sold in Manila markets.

PALÆMON IDÆ Heller.

Palæmon idæ HELLER, Sitz.-Ber. Akad. Wiss. Wien 45 (1862) 416, pl. 2, figs. 40, 41; MARTENS, Archiv. f. Naturg. Jahrg. 34 1 (1862) 39; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 5 (1891) 717.

LUZON, Laguna Bay; Camarines Sur (von Martens).

PALÆMON GRANDIMANUS Randall.

Palæmon grandimanus RANDALL, Journ. Acad. Nat. Sci. Philad. 8 (1839) 142; DANA, U. S. Explor. Exped. Crust. (1852) 588, pl. 38, fig. 12; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 5 (1891) 736.

Bithynis grandimanus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 793, pl. 129, figs. 2, 3.

Philippines (von Martens).

PALÆMON LATIMANUS Martens.

Palæmon latimanus MARTENS, Archiv. f. Naturg. Jahrg. 34 1 (1868) 44; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 5 (1891) 737, pl. 47, figs. 11, *11z*.

SAMAR (von Martens).

Genus PALÆMONELLA Dana

PALÆMONELLA ORIENTALIS Dana.

Palæmonella orientalis DANA, U. S. Explor. Exped. Crust. (1852) 582, pl. 38, fig. *4a–d;* SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 787, pl. 128, fig. 4.

Off SIBAGO, 250 fathoms, blue mud bottom (Challenger).

Family NEMATOCARCINIDÆ Spence Bate

Genus NEMATOCARCINUS A. M. Edwards

NEMATOCARCINUS ALTUS Spence Bate.

Nematocarcinus altus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 809, pl. 132, fig. 4.

South of the Philippines, 2,150 fathoms, blue mud bottom.

NEMATOCARCINUS UNDULATIPES Spence Bate.

Nematocarcinus undulatipes SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 801, pl. 130.

Off SIBAGO, 250 fathoms, blue mud bottom.

NEMATOCARCINUS TENUIROSTRIS Spence Bate.

Nematocarcinus tenuirostris SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 817, pl. 132, fig. 10; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 273.

South of the Philippines, 500 fathoms, blue mud bottom (Challenger).

NEMATOCARCINUS PRODUCTUS Spence Bate.

Nematocarcinus productus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 810, pl. 132, fig. 5.

Off Luzon, 1,050 fathoms, blue mud bottom. This species is identical with *N. ensifer* var. *producta* of de Man.[5]

TROPIOCARIDÆ

Genus NOTOSTOMUS A. M. Edwards

NOTOSTOMUS PATENTISSIMUS Spence Bate.

Notostomus patentissimus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 826, pl. 134, figs. 1, 2; DE MAN, Decapoda, Siboga Exped. 87 (1920) 46.

South of the Philippines, 2,150 fathoms, blue mud bottom (Challenger). Balss[6] placed the genus *Notostomus* under Family Hoplophoridæ. Dr. J. G. de Man[7] placed it under the same family together with the genus *Hymenodora.*

NOTOSTOMUS PERLATUS Spence Bate.

Notostomus perlatus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 831, pl. 135, fig. 2; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 268.

Near the Philippines, 2,150 fathoms, blue mud bottom (Challenger).

Genus HYMENODORA G. O. Sars

HYMENODORA ROSTRATA Spence Bate.

Hymenodora rostrata SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 846, pl. 136, fig. 4.

Off LUZON, 1,050 fathoms, blue mud bottom.

HYMENODORA GLAUCA Spence Bate.

Hymenodora glauca SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 847, pl. 137, fig. 1; DE MAN, Decapoda, Siboga Exped. 87 (1920) 47.

South of the Philippines, 2,550 fathoms (Challenger).

STYLODACTYLIDÆ

Genus STYLODACTYLUS A. M. Edwards

STYLODACTYLUS SIBOGUE de Man.

Stylodactylus sibogue DE MAN, Decapoda, Siboga Exped. pt. IV 87 (1920) 38, pl. 5, figs. 10–10*c*.

Sulu Sea, 285 fathoms, stony bottom.

[5] Siboga Exped. 87 (1920).
[6] Macrura Deutsche Tiefsee Exped. 1925.
[7] Siboga Exped. 87 (1920).

PASIPHÆIDÆ

Genus PASIPHÆA Savigny

PASIPHÆA PROPINQUA de Man.

Pasiphæa propinqua DE MAN, Decapoda, Siboga Exped. pt. 4 **87** (1920) 7, pl. 1, figs. 1, 1*j*.

Near SULU, 245 fathoms, coral bottom.

PASIPHÆA sp.

Pasiphæa sp. DE MAN, Decapoda, Siboga Exped. pt. 4 **87** (1920) 11, pls. 1, 2, figs. 4–4*p*.

Off SULU, 275 m, coral bottom.

Genus LEPTOCHELA Stimpson

LEPTOCHELA ROBUSTA Stimpson.

Leptochela robusta SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 862, pl. 139, figs. 3, 4; RATHBUN, U. S. Fish Comm. Bul. for 1903, pt. III, Wash. (1905) 929; DE MAN, Decapoda, Siboga Exped. pt. IV **87** (1920) 19, pls. 3, 4, figs. 7–7*x*.

Sulu Archipelago, 7 fathoms (Siboga).

OÖDEOPIDÆ

Genus OÖDEOPUS Spence Bate

OÖDEOPUS SERRATUS Spence Bate.

Oödeopus serratus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 877, pl. 142, figs. 2, 3.

Off Sibago Island, Zamboanga.

Tribe HAPLOPODEA

HECTARTHROPIDÆ

Genus HECTARTHROPUS Spence Bate

HECTARTHROPUS EXILIS Spence Bate.

Hectarthropus exilis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 889, pl. 144, fig. 2.

Cebu harbor; off Basilan Strait.

HECTARTHROPUS EXPANSUS Spence Bate.

Hectarthropus expansus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 892, pl. 144, figs. 4, 5.

Off Basilan Strait, on surface.

Group ABERRANTIA [8]

Genus SESTERTIUS Spence Bate

SESTERTIUS DUPLICIDENTES Spence Bate.

Sestertius duplicidentes SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 477, pl. 85, fig. 5.

Off Sibago.

Genus ZOÖNTOCARIS Spence Bate

ZOÖNTOCARIS APPROXIMUS Spence Bate.

Zoöntocaris approximus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 475, pl. 85, fig. 4.

Off Mindanao; on surface.

Division DENDROBRANCHIATA

Group NORMALIA

Tribe PENÆIDEA

Family PENÆIDÆ Spence Bate

Genus PENÆUS Fabricius

PENÆUS MONODON Fabricius.

Penæus monodon FABRICIUS, Suppl. Syst. p. 408; MILNE EDWARDS, Hist. Nat. Crust. 2 : 416.

Penæus semisulcatus DE HAAN, Crust. Fauna Japon. p. 191; DE MAN, Decapoda, Siboga Exped. pt. 1 55 (1911) 97.

Penæus carinatus DANA, U. S. Explor. Exped. Crust. (1852) 602, pl. 40, fig. 2.

LUZON, Manila markets, 0–148. The distribution is most likely throughout the Philippine waters, in shallow waters and down to twenty fathoms (possibly in still deeper waters). The Challenger specimen was secured off Panay in 20 fathoms on a mud bottom.

PENÆUS INDICUS (M. Edwards).

Penæus indicus MILNE EDWARDS, Hist. Nat. Crust. 2 : 415; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 248, pl. 33, fig. 2.

MINDORO, Batas, 0–209; off Panay (Challenger specimen) from depth of twenty fathoms on a mud bottom.

[8] "The group Aberrantia consists of several tribes and families that in their adult conditions approach more nearly to the characters common to other divisions, but which nevertheless during the progress of development pass through a stage common to the normal Phyllobranchiatic Macrura. The group has long been distinguished by carcinologists under the name of Anomura, sometimes as a division of the Macrura, and sometimes as a distinct order. It is as a separate group of the former that they are here noticed; for undoubtedly in their early stages they pass through a morphological change that is essentially macrurous."—SPENCE BATE.

PENÆUS INCISIPES Spence Bate.

Penæus incisipes SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 257, pl. 34, fig. 2.

Off Panay, depth, 20 fathoms, mud bottom.

PENÆUS FISSURUS Spence Bate.

Penæus fissurus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 263, pl. 36, fig. 1.

Near Tablas; off Cebu; 95–115 fathoms; green mud bottom.

PENÆUS GRACILIS Dana.

Penæus gracilis DANA, U. S. Explor. Exped. Crust. (1852) 606, pl. **4**, fig. *5a–b;* SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 271.

Sulu Sea, 25 miles east of Panay (Dana).

PENÆUS PHILIPPINENSIS Spence Bate.

Penæus philippinensis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 261, pl. 35, figs. 2, 3.

Basilan Strait, 82 fathoms, stone and gravel bottom.

PENÆUS RECTACUTUS Spence Bate.

Penæus rectacutus SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 266, pl. 36, fig. 2.

Metapenæus rectacutus ALCOCK and HENDERSON, Journ. Asiat. Soc. Bengal **63** (1894) 145.

Parapenæus rectacutus DE MAN, Decapoda, Siboga Exped. **55** (1911) 82; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 228.

Between Bohol and Cebu, 95 fathoms, blue mud bottom (Challenger).

Genus HEMIPENÆUS Spence Bate

HEMIPENÆUS VIRILIS Spence Bate.

Hemipenæus virilis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 305, pl. 44, fig. 4.

Off Sibago, 250 fathoms, green mud bottom.

HEMIPENÆUS TOMENTOSUS Spence Bate.

Hemipenæus tomentosus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 307, pl. 40, figs. 2, 3; pl. 50.

Off Sibago, 250 fathoms, green mud bottom.

HEMIPENÆUS SPINODORSALIS Spence Bate.

Hemipenæus spinodorsalis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 301, pl. 44, fig. 1.

South of the Philippines, 2,050 fathoms, blue mud bottom.

HEMIPENÆUS GRACILIS Spence Bate.

Hemipenæus gracilis SPENCE BATE, Rept. Voy. Challenger, Zool. **24** (1873–76) 302, pl. 44, fig. 2.

Off Tablas, 700 fathoms, blue mud bottom.

Genus HALIPORUS Spence Bate

HALIPORUS EQUALIS Spence Bate.

Haliporus equalis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 285, pl. 41, fig. 1.

Between the Philippines and Borneo, 250 fathoms, green mud bottom.

HALIPORUS LÆVIS Spence Bate.

Haliporus lævis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 289, pl. 42, fig. 2.

Off Luzon, 1,050 fathoms, green mud bottom.

Genus BENTHESICYMUS Spence Bate

BENTHESICYMUS PLEOCANTHUS Spence Bate.

Benthesicymus pleocanthus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 334, pl. 57, fig. 2.

Off Luzon, 1,050 fathoms, blue mud bottom.

BENTHESICYMUS ALTUS Spence Bate.

Benthesicymus altus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 336, pl. 57.

South of the Philippines, 500 to 1,050 fathoms, blue mud bottom.

Genus ARISTEUS Duvernoy

ARISTEUS ARMATUS Spence Bate.

Aristeus armatus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 312, pls. 45, 46.

Aristeopsis Armatus BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 222.

South of the Philippines, 2,050 fathoms, blue mud bottom (Challenger).

Genus GENNADAS Spence Bate

GENNADAS PARVUS Spence Bate.

Gennadas parvus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 340, pl. 59.

Philippines, west of Manila, 2,100 fathoms, blue mud bottom.

SERGESTIDÆ

LUCIFERINÆ

Genus LUCIFER Vaughan Thompson

LUCIFER TYPUS Thompson.

Lucifer typus VAUGHAN THOMPSON, Zool. Researches (1829) 58, pl. 7, fig. 2; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 464, pl. 83; ROXAS, Rept. Puerto Galera Marine Biol. Lab. List of Anim. (1930).

Lucifer pacificus DANA, U. S. Explor. Exped. Crust. (1852) 673, pl. 45, fig. 2 (young).

Pelagic, abundant in plankton around Puerto Galera, Mindoro; Mindanao, off Zamboanga Province (Challenger).

LUCIFER REYNAUDII Milne Edwards.

Lucifer reynaudii MILNE EDWARDS, Hist. Nat. Crust. 2 : 469; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 466, pl. 84.

MINDANAO, off Zamboanga Province, on surface (Challenger).

SERGESTINÆ

Genus SERGESTES Milne Edwards

SERGESTES INTERMEDIUS Spence Bate.

Sergestes intermedius SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 383.

China Sea, off LUZON.

SERGESTES JAPONICUS Spence Bate.

Sergestes japonicus SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 387, pl. 70, figs. 1, 2.

Off Manila, 700 fathoms, blue mud bottom.

Genus ACANTHOSOMA Spence Bate

ACANTHOSOMA MACROTELSONIS Spence Bate.

Acanthosoma macrotelsonis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 374, pl. 66, fig. 1.

MINDANAO, Zamboanga Province, from plankton. Spence Bate believed this to be a young stage of one of the species of *Sergestes*.

Division TRICHOBRANCHIATA

Group NORMALIA

Tribe SYNAXIDEA

SCYLLARIDÆ

Genus IBACCUS Leach

IBACCUS CILIATUS (v. Siebold)

Scyllarus ciliatus v. Siebold, DE HAAN, Fauna Japon. (1850) 153, pl. 36; pl. 37, fig. 2.

LUZON, Manila Bay, 0–17.

IBACCUS VERDI Spence Bate.

Ibaccus verdi SPENCE BATE, Rept. Voy Challenger, Zool. 24 (1873–76) 58, pl. 7, fig. 2; pl. 8.

Off Zamboanga, 250 fathoms, green mud bottom.

Genus ARCTUS Dana

ARCTUS ORIENTALIS Spence Bate.

Arctus orientalis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 68, pl. 9, fig. 4; ALCOCK, Cat. Indian Deep-Sea Crust. Decapoda and Anomala, Indian Mus. Calcutta (1901) 181.

Between Bohol and Cebu; 95 fathoms, blue mud bottom (Challenger).

Genus SCYLLARUS Fabricius

SCYLLARUS SORDIDUS (Stimpson).

Arctus sordidus STIMPSON, Proc. Acad. Nat. Sci. Phila. Jan. (1860) 23.

Scyllarus sordidus G. NOBILI, Bollet. Mus. Torino, No. 455 18 (1903) 12; DE MAN, Decapoda, Siboga, Exped. pt. III 76 (1916) 65, pl. 2, figs. 11, 11*a*.

Philippines (Siboga).

SCYLLARUS GIBBEROSUS (de Man).

Arctus gibberosus DE MAN, Tijdschr. d. Ned. Dierk. Vereen (2) Dl. 9 (1905) 588.

Scyllarus gibberosus DE MAN, Siboga Exped. pt. III 76 (1916) 90, pl. 3, figs. 14–14*d*.

Off north Ubian, 6° 7′ 5″ north latitude, 120° 26′ east longitude (Siboga).

SCYLLARUS MARTENSII Pfeffer.

Scyllarus martensii BORRADAILLE, Fauna and Geog. Maldive and Laccadive Archipelago, pt. III 2 (1904) 754, pl. 58; fig. 4; RATHBUN, Brachyura and Macrura, Hawaiian Is., Wash. (1906) 896, pl. 18, fig. 2; DE MAN, Siboga Exped. pt. III 76 (1916) 84, pl. 3, figs. 13, 13*a*.

SULU, Sulu harbor, 14 m, sandy bottom (Siboga).

Genus THENUS Leach

THENUS ORIENTALIS Rumphius.

Thenus orientalis MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 286; HASWELL, Cat. Austral. Crust. (1882) 170; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 6 (1892) 46.

CEBU (Ortmann).

PALINURIDÆ

Genus PANULIRUS White

PANULIRUS PENICILLATUS (Olivier).

Palinurus penicillatus A. G. OLIVIER, Encycl. Method. 8 (1811) 674; H. M. EDWARDS, Hist. Nat. Crust. 2 (1837) 299.

Senex penicillatus ORTMANN, Zool. Jahrb. Abth. f. Syst. 6 (1891) 28.

Panulirus penicillatus RATHBUN, Brachyura and Macrura Hawaiian Is., Wash. (1906) 897.

MINDORO, Mindoro Province, Puerto Galera, 0–378; 0–376, 0–1640, places not indicated.

PANULIRUS ORNATUS (Fabricius).

Palinurus ornatus FABRICIUS, Suppl. Entom. Syst. (1798) 400.

Panulirus homarus G. NOBILI, Ann. Sci. Nat. (9), Zoöl. 4 (1906) 90.

MINDORO, Mindoro Province, Puerto Galera, 0–386; LUZON, Zambales Province, Olongapo, 0–278.

PANULIRUS VERSICOLOR (Latreille).

Palinurus versicolor LATREILLE, Ann. du Mus. 3 (1804) 394.
Palinurus fasciatus DE HAAN, Fauna Japon. Crust. (1850) 159, pl. 43, fig. 2.
Panulirus versicolor G. NOBILI, Bul. Sci. France-Belgique 40 (1906) 59; DE MAN, Decapoda, Siboga, Exped. pt. III 76 (1916) 55, pl. 2, figs. 7–7*c*.

MINDORO, Mindoro Province, Puerto Galera, 0–722, 0–20.

Tribe ASTACIDEA

ERYONIDÆ

Genus PENTACHELES Spence Bate

PENTACHELES LÆVIS Spence Bate.

Pentacheles lævis SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 144, pl. 15, fig. 5; SPENCE BATE, Ann. Mag. Nat. Hist. (5) 2 (1878) 278.

South of the Philippines, 500 fathoms, blue mud bottom (Challenger).

HOMARIDÆ

Genus NEPHROPS Leach

NEPHROPS THOMSONI Spence Bate.

Nephrops thomsoni SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 185, pls. 25, 26.

Off TABLAS, 100 fathoms, green mud bottom.

Tribe STENOPIDEA

Family STENOPIDÆ Spence Bate

Genus STENOPUS Latreille

STENOPUS HISPIDUS Adams and White.

Stenopus hispidus DANA, U. S. Explor. Exped. Crust. (1852) 607, pl. 40, fig. 8; SPENCE BATE, Voy. Challenger, Zoöl. 24 (1873–76) 211, pl. 30; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 233.

MINDORO, Mindoro Province, Calapan and Puerto Galera, 0–1841.

Genus SPONGICOLA de Haan

SPONGICOLA VENUSTA de Haan.

Spongicola venusta DE HAAN, Fauna Japon. Crust. (1850) 194, pl. 46, fig. 9; MIERS, Journ. Linn. Soc. London 13 : 507, pl. 24, figs. 1, 2; SPENCE BATE, Rept. Voy. Challenger, Zool. 24 (1873–76) 213, pl. 29.

Off Cebu, 95 fathoms, blue mud bottom (Challenger).

Group ABERRANTIA

Family GALATHEIDÆ Dana

Genus GALATHEA Fabricius

GALATHEA ELEGANS White.

Galathea elegans WHITE, List Crust. Brit. Mus. (1847) 66; MIERS, Crust. Zoöl. H. M. S. Albert (1884) 278.

MINDORO, Mindoro Province, Puerto Galera, 0–1823. This beautifully colored species is found almost invariably in pairs.

GALATHEA SUBSQUAMATA Stimpson.

Galathea subsquamata STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 90.

Off Tablas, 100 to 115 fathoms, green mud bottom (Challenger).

GALATHEA GRANDIROSTRIS Stimpson.

Galathea grandirostris STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 90.

Off CEBU, 95 to 100 fathoms, blue mud bottom (Challenger).

GALATHEA ACULEATA Haswell.

Galathea aculeata HASWELL, Proc. Linn. Soc. N. S. W. **6** (1882) 761.

Off Manila, 18 fathoms, blue mud bottom (Challenger).

Genus MUNIDA Leach

MUNIDA INCERTA Henderson.

Munida incerta HENDERSON, Rept. Voy. Challenger, Zoöl. **27** (1888) 130, pl. 13, fig. 4; BENEDICT, Proc. U. S. N. M. No. 1311 **26** : 307.

Off Siboga, 250 fathoms, green mud bottom (Challenger).

MUNIDA MILITARIS var. CURVIROSTRIS Henderson.

Munida curvirostris HENDERSON, Ann. & Mag. Nat. Sci. (5) **16** (1885) 412; BENEDICT, Proc. U. S. N. M. No. 1311 **16**: 307.

Munida militaris var. *curvirostris* HENDERSON, Rept. Voy. Challenger, Zool. **27** (1888) 139, pl. 3, fig. 7.

SIBOGA, 250 fathoms; green mud bottom (Challenger). Cebu (Benedict), 375 fathoms; blue mud bottom.

Genus MUNIDOPSIS Whiteaves

MUNIDOPSIS MILLERI Henderson.

Munidopsis milleri HENDERSON, Ann. & Mag. Nat. Hist. (5) **16** (1885) 414.

Off Tablas Island, 700 fathoms, blue mud bottom (Challenger).

MUNIDOPSIS PILOSA Henderson.

Munidopsis pilosa HENDERSON, Ann. & Mag. Nat. Hist. (5) **16** (1885) 415.

Near the Philippines, 825 fathoms; hard ground bottom (Challenger).

Genus ELASMONOTUS A. M. Edwards

ELASMONOTUS DEBILIS Henderson.

Galathopsis debilis HENDERSON, Ann. & Mag. Nat. Hist. (5) **16** (1885) 415.

Elasmonotus debilis HENDERSON, Rept. Voy. Challenger, Zool. **27** (1888).

PHILIPPINES, 375 fathoms; blue mud bottom.

Genus UROPTYCHUS Henderson

UROPTYCHUS SPINIMARGINATUS Henderson.

Diptychus spinimarginatus HENDERSON, Ann. Mag. Nat. Hist. (5) **16** (1885) 419.

Uroptychus spinimarginatus HENDERSON, Rept. Voy. Challenger, Zool. 27 (1888) 176, pl. 21, fig. 2; BENEDICT, Proc. U. S. N. M. **26** : 333.

South of the Philippines, 500 fathoms, blue mud bottom (Challenger).

THALASSINIDÆ

Genus THALASSINA Latreille

THALASSINA ANOMALA (Herbst).

Cancer anomalous HERBST, Krabben u. Krebse III (1803) 45, pl. 62.
Thalassina scorpionides LATREILLE, Gen. Crust. et Ins. **1** (1807) 51.
Thalassina anomala DE MAN, Journ. Linn. Soc. London 22 (1888) 260.

MINDORO, Mindoro Province, Puerto Galera 0–8. LUZON, Manila, Malate, 0–29, 0225; Zambales, Subic, 0224. PALAWAN, Busuanca, 0279. MACTAN, Cebu, 0220. BASILAN, Zamboanga, 0221. TAWITAWI, 0223.

CALLIANISSIIDÆ

Genus CALLIANASSA Leach

CALLIANASSA MUCRONATA Strahl.

Callianassa mucronata STRAHL, Mon. Ber. Akad. Wiss. Berlin (1861) 1056; A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris **6** (1870) 94; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. **6** (1892) 57.

Philippines (Strahl).

Genus GEBIA Leach

GEBIA BARBATA Strahl.

Gebia barbata STRAHL, Mon. Akad. Wiss. Berlin (1861) 1062; ORTMANN, Decapod. Krebse, Strassburger Mus. Zool. Jahrb. Syst. **6** (1892) 54, pl. 1, fig. 8.

LUZON (Strahl).

AXIIDÆ

Genus AXIUS Leach

Subgenus NEAXIUS Borradaile

AXIUS (NEAXIUS) PLECTRORHYNCHUS Strahl.

Axius (Neaxius) plectrorhynchus DE MAN, Decapoda, Siboga Exped. 101–104 (1925) 4.

LUZON, between tide marks, 3 to 4 fathoms below tide marks.

AXIUS (EICONAXIUS) SIBOGUE de Man.

Axius (Eiconaxius) sibogue DE MAN, Decapod. Siboga, Exped. pt. VI 101–104 (1925) 34, figs. 4–*4h*.

Sulu Sea, 285 fathoms, stony bottom.

Genus AXIOPSIS Borradaile

AXIOPSIS (AXIOPSIS) CONSABRINA de Man.

Axiopsis (Axiopsis) consabrina DE MAN, Decapoda, Siboga Exped. pt. 6 101–104 (1925) 80.

Sulu Sea, 150 fathoms, coral bottom.

Genus SCYTOLEPTUS Gerstaecker

SCYTOLEPTUS SERRIPES Gerstaecker.

Scytoleptus serripes A. GERSTAECKER, Archiv. f. Naturg. 22 (1856) 158, pl. 6, figs. 1–4; HILGENDORF, Monatsber. Kön. Akad. Wiss. Berl. Now. (1878) 827; DE MAN, Decapod. Siboga Exped. pt. VI 101–104 (1925) 49.

Luzon (Siboga).

Suborder ANOMURA [9]

Tribe PAGURIDEA

Section PAGURODEA Henderson

Branch LAMINIBRANCHIATA

Family PAGURIDÆ Dana

Genus CLIBANARIUS Dana

CLIBANARIUS CORALLINUS (Milne Edwards).

Pagurus corallinus MILNE EDWARDS, Ann. Sci. Nat. Zool. (3) 10 (1848) 63.

Clibanarius corallinus ALCOCK, Cat. Ind. Decapod. Crust. II, Fasc. 1 (1905) 48, pl. 5, fig. 1.

LUZON, Manila Bay, 0–343. MEDIO, Mindoro Province, Puerto Galera, 0–461.

[9] The anomurans occupy an indefinite position between the Macrura and Brachyura. In some systematic works they have been divided into two subdivisions—Macrura Anomalia and Brachyura Anomalia.

The system adopted in this work is that of Henderson (Challenger Rept. Zool. 27). Some of the specimens included in the list are labeled but not numbered.

CLIBANARIUS ANTILLENSIS Stimpson.

Clibanarius antillensis STIMPSON, Ann. Lyc. Nat. Hist. 7 (1859) 85; BENEDICT, Bul. U. S. Fish Comm. 20 (1900) 142, pl. 6, fig. 1.

MINDORO, Mindoro Province, Puerto Galera. PALAWAN, Taytay.

CLIBANARIUS CRUENTATUS (Milne Edwards).

Pagurus cruentatus MILNE EDWARDS, Ann. Sci. Nat. Zool. (3) 10 (1848) 62.

PALAWAN, Taytay, 0–1214; MINDORO, Mindoro Province, Puerto Galera, 0–1921.

CLIBANARIUS ERYSTERNUS Hilgendorf.

Clibanarius erysternus DE MAN, Archiv. f. Naturg. 53 (1887) 447.

LUZON, Manila Bay, 0–345. MINDORO, Mindoro Province, Puerto Galera, 0–457.

CLIBANARIUS CLIBANARIUS (Herbst).

Cancer clibanarius HERBST, Krabben u. Krebse 2 (1791) 20, pl. 23, fig. 1.

Clibanarius clibanarius HILGENDORF, M. B. K. Akad. Berlin (1878) 820.

PALAWAN, Taytay, 0–1241; 0–1738, not indicated.

CLIBANARIUS INFRASPINATUS Hilgendorf.

Clibanarius infraspinatus HILGENDORF, in V. d. Decken's Reisen Ost-Afric III 1 (1869) 97.

LUZON, Bataan; Mariveles, 0–276. PALAWAN, Taytay. MINDORO, Mindoro Province, Puerto Galera.

CLIBANARIUS STRIOLATUS Dana.

Clibanarius striolatus DANA, U. S. Explor. Exped. Crust. 1 (1852) 463, pl. 24, figs. 3*a–e*.

PALAWAN, Taytay, 0–1318.

CLIBANARIUS SCLOPETARIUS Herbst.

Clibanarius sclopetarius HERBST, Krabben u. Krebse 2 (1796) 23, pl. 23, fig. 3; BENEDICT, Bul. U. S. Fish Comm. 20 (1900) 142.

MINDORO, Mindoro Province, Puerto Galera, 0–459. PALAWAN, Taytay, 0–1900.

CLIBANARIUS PADAVENSIS de Man.

Clibanarius padavensis ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 44, pl. 4, fig. 2.

MINDORO, Mindoro Province, Puerto Galera, 0–1813; LUZON, Manila Bay.

CLIBANARIUS PHILIPPINENSIS Yapchiongco sp. nov.

Small, scarcely setose except towards the extremities of chelipeds and legs; antennal angles of carapace yellowish white; fingers of chelipeds white; propodite of legs with dark-violet rings around distal ends; dactyli white; dactylus of third left leg shorter than its propodus. Carapace elongated, its greatest breadth about five eighths of its length; gastric region deeply punctate and hardly setose; branchial region with a trans-

verse series of hair tufts immediately behind cervical groove; rostral projection small and triangular; antennal angles of carapace yellowish white, less intensely so at rostrum. Ocular stalk moderately slender, slightly shorter than front border of carapace but slightly longer than antennular peduncle; eyes, with white ring around base, occupying about one seventh or more of length of stalk; ophthalmic scales broad, truncate, with two spinules on the inner anterior margin. Antennal acicle long and slender, spinose on the dorsal side, especially about tip; apices calcareous white and parallel to base of last joint of peduncle; second segment of peduncle with one projecting spine on outer upper distal margin and another on inner inferior border about some distance behind distal end. Chelipeds similar in form but subequal, the right slightly the larger; lower inner margin of merus serrate; general surface with yellowish or white, squamiform tubercles scattered here and there; distal outer edge of merus armed with two spinules; carpus with a strong spine and few elevated tubercles on distal upper inner border; hand flat dorsally, swollen at base and globular below; dorsal surface of hand studded with high conical tubercles; fingers yellowish-white and armed with spinose tubercles towards apices; finger tips corneous and blackish brown. Crawling legs longer than chelipeds; merus of third pair of legs with dark violet spots on both upper and lower borders which tend to meet medially; carpus of legs with a single spine on upper distal end; propodus of legs provided with a dark violet ring around the distal end; penultimate segment of third left leg convex, with a slight ridge converging medially; upper edge cristiform; dactylus shorter than propodite; dactyli of legs whitish yellow with black corneous apices; ischiopodites studded with low elevated granules. Chelipeds and legs become more setose gradually towards their extremities.

LUZON, Manila Bay, 0–1901. PALAWAN, Taytay.

Genus PAGURUS Fabricius

PAGURUS BIFORMIS Milne Edwards.

Pagurus bifermis MILNE EDWARDS, Ann. Sci. Nat. Zool. (2) 6 : 229.
Pagurus cultrerus WHITE, List Crust. Brit. Mus. (1848) 60.

MINDORO, Mindoro Province, Puerto Galera, Calapan. PALAWAN, Taytay.

PAGURUS DERMATUS Henderson.

Pagurus dermatus HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 58.

MINDORO, Mindoro Province, Puerto Galera.

PAGURUS ASPER de Haan.

Pagurus asper DE HAAN, Faun. Japon. (1849) 208, pl. 49, fig. 4.
Dardanus haani RATHBUN, Proc.. U. S. N. M. (1903) 34.

Shores of MINDORO.

PAGURUS VULNERANS Thallwitz.

Pagurus vulnerans THALLWITZ, Abh. u. Ber. k. Zoöl. Mus. No. 3 (1890) 33.

MINDORO, Mindoro Province, Puerto Galera, 0.450. PALAWAN, Balabac Strait, 0–1419.

PAGURUS PUNCTULATUS Olivier.

Cancer magistes HERBST, Krabben u. Krebse 3 (1804) 23, pl. 11, fig. 1.
Pagurus punctulatus OLIVIER, Encycl. Method. 8 (1811) 639.

MINDORO, Mindoro Province, Puerto Galera and Calapan. PALAWAN, Taytay.

PAGURUS WOOD-MASONI Alcock.

Pagurus wood-masoni ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 85, pl. 9, fig. 3.

MINDORO, Mindoro Province, Puerto Galera.

PAGURUS FABIMANUS Dana.

Pagurus fabimanus DANA, U. S. Explor. Exped. Crust. 1 (1852) 454, pl. 28, figs. 7*a–c*.

MINDORO, Mindoro Province, Puerto Galera, 0–721.

PAGURUS EUOPSIS Dana.

Pagurus euopsis DANA, U. S. Explor. Exped. Crust. 1 (1852) 452, pl. 27, figs. 6*a–c*.
Pagurus depressus HELLER, S. B. K. Akad. Wien 44 (1861) 248.

MINDORO Coast, 0–1536.

PAGURUS GUTTATUS Olivier.

Pagurus guttatus OLIVIER, Encycl. Method. 8 (1811) 640.
Pagurus setifer HESS, Archiv. f. Nat. 31 (1865) 161.

MINDORO, Mindoro Province, Puerto Galera, 0–1920.

PAGURUS SEMILIMANUS Henderson.

Pagarus semilimanus HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 59, pl. 6, fig. 6.

MINDANAO, off Zamboanga Province, 375 fathoms, blue mud bottom.

PAGURUS STRIATUS Latreille.

Cancer arroser HERBST, Naturg. Krabben u. Krebse 2 (1796) 170, pl. 43, fig. 1.
Pagurus striatus LATREILLE, Hist. Nat. Crust. et Insect. 7 (1802) 163.

Off CEBU, on a reef. TABLAS, 100 to 115 fathoms, green mud bottom (Challenger).

Genus ANICULUS Dana

ANICULUS ANICULUS (Herbst).

Cancer aniculus HERBST, Krabben u. Krebse 2 (1791) 37.
Pagurus aniculus FABRICIUS, Ent. Syst. 2 (1793).
Aniculus aniculus ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 94, pl. 7, fig. 6.

MINDORO, Mindoro Province, Puerto Galera, 0–60, 0–170, 0–377.

Genus DIOGENES Dana

DIOGENES AVARUS Heller.

Diogenes avarus HELLER, Novara Crust. (1866) 83, pl. 7, fig. 2.

MINDORO, Mindoro Province, Puerto Galera, 0–1924.

DIOGENES BREVIROSTRIS Stimpson.

Diogenes brevirostris STIMPSON, Smithsonian Mus. Coll. 49 (1907) 201, pl. 19, fig. 2.

PALAWAN, Taytay.

DIOGENES LANARIS Yapchiongco.

Diogenes lanaris YAPCHIONGCO (in MS, 1933).

Carapace elongate with greatest breadth across branchial region about five-sixths of sagittal length; gastric region smooth at center but roughened towards sides by anteriorly tilted and elevated scalelike plates whose edges are cut into minute spinules; edges also fringed with beautiful, metallic, silky yellowish bristles. Anterolateral borders of carapace finely spinulate; rostriform process merely a slender strongly acuminate spinule, slightly surpassing ophthalmic scales.

Eyestalk slender, longer than front border of carapace by a third or less of its length and shorter than antennular peduncle by a corneal length; cornea not dilated; ophthalmic scale arcuate with four or five dentines on anterior border. Antennal peduncle moderately long, reaching halfway to last segment of antennular; antennal acicle vertically laminate, acuminate, and provided with four calcareous spines on superior edge, reaching beyond base of last segment of peduncle.

Chelipeds plumose, the left much longer; denuded outer surface covered with irregular platelike granules. External surface of merus covered with similar granules gradually becoming elevated, blunt tubercles towards the inferior edge; lower outer margin serrate; its superior border sharp and crenulate, the last two tubercles becoming clawlike spines distally. Outer surface of carpus tuberculose and alternated with calcareous spines arranged in rows of twos and threes; outer distal margin beset with spinules, the spinules tending to become spines towards superior border; dorsal edge produced into a vertical crest a short distance from proximal end towards middle. Crest mounted with six strong calcareous spines at distal half, gradually merging into general surface anteriorly. Palm with a short longitudinal median carina or ridge on proximal half of extensor area which merges into general surface distally; ridge beset with five to seven white spines; halfway between this ridge and the superior border on same surface a dorsally concave, linear series of calcareous spinules reaching base of mobile finger. Other spinules on general sur-

face, especially on distal portion, each one occupying an intersection of borders of platelike granules. Hand about twice as long as wide; superior border raised into a dikelike elevation armed with spinose tubercles flanking one or two series of larger spines. Inferior margin likewise beset with one or two series of thornlike spinules. Fingers roughened by conical spines; superior border of dactylus spinulated, a continuation from same border of hand; fixed finger somewhat deflexed; finger apices acuminate. Right cheliped smooth and absolutely unarmed though greatly plumose. Left crawling legs slightly exceeding apex of big cheliped; like chelipeds, legs plumose with wooly hairs mostly confined on upper and lower borders.

PALAWAN, Taytay, 0–1797. Type specimen is in the Collection of the Zoölogy Department, University of the Philippines.

Genus CALCINUS Dana

CALCINUS HERBSTII de Man.

Pagurus tilicen MILNE EDWARDS, Ann. Sci. Zoöl. (2) 5 (1836) 278.
Pagurus lævimanus RANDALL, Journ. Acad. Philad. 7 (1839) 135.
Calcinus herbstii ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 53, pl. 5, fig. 4.

LUZON, Rizal Province, Pasay, 0–345. MINDORO, Mindoro Province, Puerto Galera, 0–327.

CALCINUS ELEGANS (Milne Edwards).

Pagurus elegans MILNE EDWARDS, Hist. Nat. Crust. (1837) 229.
Calcinus elegans DANA, U. S. Explor. Exped. Crust. 1 (1852) 458, pl. 27, fig. 10.

MINDORO, Mindoro Province, Puerto Galera, 0–333.

CALCINUS TERRÆ-REGINÆ Haswell.

Calcinus terræ-reginæ HASWELL, Proc. Linn. Soc. N. S. Wales 6 (1881) 760.

MINDORO, Mindoro Province, Puerto Galera, 0–1906.

CALCINUS LATENS (Randall).

Pagurus latens RANDALL, Journ. Acad. Philad. (1839) 135.
Calcinus intermedius DE MAN, Notes Leyden Mus. 3 (1881) 102.
Calcinus latens ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 58, pl. 5, fig. 5.

MINDORO, Mindoro Province, Puerto Galera, 0–1923.

Genus EUPAGURUS Brandt

EUPAGURUS JANITOR Alcock.

Eupagurus janitor ALCOCK, Cat. Ind. Decapod. Crust. Fasc. I 2 (1905) 132, pl. 11, fig. 6.

BACO, Calapan. MINDORO, Mindoro Province, Puerto Galera, 0–1517, 0–1922, 01521.

EUPAGURUS SPINOLENTUS Henderson.

Eupagurus spinolentus HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 68, pl. 7, fig. 3.

Off TABLAS, 100 to 115 fathoms, green mud bottom.

Genus PAGURISTES Dana

PAGURISTES HIANS Henderson.

Paguristes hians HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 79, pl. 8, fig. 4.

Off Manila, 18 fathoms, blue mud bottom.

Genus SPIROPAGURUS Stimpson

SPIROPAGURUS SPIRIGER (de Haan).

Pagurus spiriger DE HAAN, Faun. Japon. Crust. (1850) 206 pl. 49, fig. 2.

Spiropagurus spiriger STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 86; HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 72.

Off Manila, 18 fathoms, blue mud bottom (Challenger).

Family CŒNOBITIDÆ Dana

Genus BIRGUS Leach

BIRGUS LATRO (Linn.)

Cancer crementatus RUMPHIUS, D' Amboinisch Rariteitkamer (1705) 7, pl. 4.

Pagurus latro FABRICIUS, Suppl. Ent. Syst. (1798) 411.

Birgus latro LEACH, Trans. Linn. Soc. London 11 (1815) 337.

Of very wide distribution in the Philippines; specimens had been collected from CABRO, Mindanao; CAMOTES, Cebu Province; SAMAR; LUZON, Cagayan Province, Claveria; PALAWAN; The Batanes Group, and other places.

Genus CŒNOBITA Latreille

CŒNOBITA RUGOSA Milne Edwards.

Cœnobita rugosa MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 241; DANA, U. S. Explor. Exped. Crust. (1852) 471, pl. 30, figs. 1, 2.

Cœnobita compressa var. *rugosa* BOUVIER, Bul. Sci. Philom. (8) 3 (1890) 21.

MINDANAO, Lanao Province, Kolambugan, 0–928. PALAWAN, Taytay, 0–1225; Sulu Sea (Dana).

CŒNOBITA PERLATA Milne Edwards.

Cœnobita perlata MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 242.

Cœnobita purpurea STIMPSON, Proc. Acad. Nat. Sci. Philad. (1852) 245.

MINDORO, Mindoro Province, Puerto Galera, 0–1903.

CŒNOBITA CAVIPES Stimpson.

Cœnobita cavipes STIMPSON, Proc. Acad. Nat. Sci. Philad. (1852) 254.

Cœnobita violascens HELLER, Verh. Zool. Bot. Ges. Wien 12 (1862) 524.

Cœnobita compressa MIERS, Ann. Mag. Nat. Hist. (5) 5 (1880) 371.

PALAWAN, Taytay, 0–1222. SAMAR, Batag, 0–964.

CŒNOBITA CLYPEATA (Herbst).

Cancer clypeata HERBST, Krabben u. Krebse 2 (1796) 22, pl. 23, fig. 2.
Cœnobita clypeata LATREILLE, Fam. Nat. du. Anim. (1828) 277.

From the shores of MINDANAO, 0–31, 0–442, 0–1880.

Branch FIBRIBRANCHIATA Henderson

Family PARAPAGURIDÆ S. I. Smith

Genus PAGURODES Henderson

PAGURODES PILIFEROUS Henderson.

Pagurodes piliferous HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 96, pl. 9, fig. 5.

Off Tablas, 100 to 115 fathoms, green mud bottom.

PAGURODES LIMATULUS Henderson.

Pagurodes limatulus HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 97, pl. 10, fig. 6.

South of the Philippines, 500 fathoms, blue mud bottom.

Genus PAGUROPSIS Henderson

PAGUROPSIS TYPICUS Henderson.

Paguropsis typicus HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 99, pl. 10, fig. 4.

Off Tablas, 100 to 115 fathoms, green mud bottom.

Genus PARAPAGURUS Henderson

PARAPAGURUS ABYSORUM A. M. Edwards in MS.

Parapagurus abysorum HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 86.

Off the Philippines, 1,075 fathoms, blue mud bottom.

Tribe PORCELLANIDEA

Section PORCELLANODEA Henderson

Family PORCELLANIDÆ Dana

Genus PETROLISTHES Stimpson

PETROLISTHES RATHBUNÆ Schmitt.

Petrolisthes rathbunæ SCHMITT, Decapod. Crust. Cal. Univ. Pub. Zoöl. 23 (1921) 181, pl. 32, fig. 3.

LUZON, Tayabas Province, Atimonan, 0–1772; Bataan Province, Mariveles 0–1751.

PETROLISTHES GRACILIS Stimpson.

Petrolisthes gracilis STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1862) 74; SCHMITT, Decapod. Crust. Cal. Univ. Pub. Zoöl. 23 (1921) 181, pl. 32, fig. 4.

LUZON, Tayabas Province, Atimonan, 0–1771.

PETROLISTHES ERIOMERUS Stimpson.

Petrolisthes eriomerus STIMPSON, Ann. Lyc. Nat. Hist. New York 10 (1871) 119; SCHMITT, Decapod. Crust. Cal. Univ. Pub. Zoöl. 23 (1921) 180, pl. 32, fig. 2.

Mindoro, Mindoro Province, Puerto Galera.

PETROLISTHES MARGINATUS Stimpson.

Petrolisthes marginatus STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1859) 74; BENEDICT, Anomuran Coll. Fish Hawk Exped. Porto Rico (1901) 134, pl. 3, fig. 1.

MINDORO, Mindoro Province, Puerto Galera, 0–1802.

Genus PISISOMA Stimpson

PISISOMA SCULPTUM (Milne Edwards).

Porcellana sculpta MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 253; DANA, U. S. Explor. Exped. (1852) 412, pl. 26, fig. 2.

Porcellana pulchella Haswell, Cat. Austral. Crust. (1882) 148.

Pachycheles pulchellus MIERS, Rept. Zoöl. Coll. "Alert" (1848) 273, pl. 30, fig. A.

Pisisoma sculptum ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 6 (1892) 265.

Sulu Sea (Dana).

Henderson[10] grouped the families Galatheidæ and Porcellanidæ to constitute the Tribe Galatheidea of Anomura. Spence Bate[11] placed Galatheidæ in the Division Trichobranchiata, Group Aberrantia of Macrura. This family is retained in this position in this paper.

Galathea is much more macrurous in general appearance, while *Petrolisthes* resembles the brachyurans, its flattened, broad and almost quadrangular cephalothorax making it appear very much like the true crabs. Its anomuran characteristics are only the long antennæ, the presence of uropods, and the fact that the pleura of the abdominal segments are separate, not fused.

The writer proposes that the Section Porcellanodea be raised to the tribe Porcellanidea, pending the study of the comparative anatomy of the nervous system and the degree of cephalization in these groups.

Tribe HIPPIDEA

Family HIPPIDÆ Dana

Genus REMIPES Stimpson

REMIPES TESTUDINARIUS Latreille.

? *Hippa adactyla* FABRICIUS, Ent. Syst. 2 (1793) 474; LATREILLE, Hist. Nat. Crust. 6 (1803) 176.

Cancer emeritus HERBST, Naturg. Krabben u. Krebse 2 (1796) 8, pl. 22, fig. 4.

[10] Chall. Rept. Zool. 27 (1888). [11] Chall. Rept. Zool. 24 (1888).

Remipes testudinarius LATREILLE, Gen. Crust. et Ins. 1 (1806) 45; LAMARCK, Hist. Anim. sans Vert. 5 (1818) 223; DESMAREST, Consid. Crust. (1825) 175, pl. 29, fig. 1; HELLER, Reise der Novara, Crust. (1865) 72; MIERS, Journ. Linn. Soc. Zoöl. 14 (1879) 312.

Remipes marmoratus WHITE, List, Crust. Brit. Mus. (1847) 58 sine descr.

Remipes pacificus DANA, U. S. Explor. Exped. 13 (1852) 407, pl. 25, fig. 7; STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1862) 241.

Very widely distributed in the Philippines. Specimens were collected from GUIMARAS, Iloilo; CEBU; MINDORO, Mindoro Province, Puerto Galera; LUZON, Bauan, Batangas; La Union Province, Ilocos Sur Province, Ilocos Norte Province, and other places. Quite common along the water line where the sand is coarse and loose.

REMIPES TESTUDINARIUS var. DENTICULATIFRONS (White).

Remipes testudinarius var. *denticulatifrons* MIERS, Journ. Linn. Soc. Zoöl. 14 (1879) 318.

CEBU, 0–1182. The variety is quite rare.

Genus MASTIGOCHIRUS Stimpson

MASTIGOCHIRUS QUADRILOBATUS Miers.

Mastigochirus quadrilobatus MIERS, Journ. Linn. Soc. Zoöl. 14 (1879) 322, pl. 5, fig. 8.

GUIMARAS (Miers).

Family ALBUNEIDÆ Stimpson

Genus ALBUNEA Fabricius

ALBUNEA SYMNISTA (Linnæus).

Cancer symnista LINNÆUS, Syst. Nat. (1766) 1053.

Hippa symnista FABRICIUS, Ent. Syst. 2 (1793) 474.

Albunea symnista MIERS, Journ. Linn. Soc. Zoöl. 14 (1879) 326.

LUZON, La Union Province, 0–1852; Ilocos Sur Province; Cagayan Province, Aparri.

This species differs from the allied species *R. testudinarius* in preferring as habitat the more compact and finer sand.

ALBUNEA MICROPS White.

Albunea microps WHITE, List Crust. Brit. Mus. Append. (1847) 129.

Sulu Sea, 10 fathoms (Miers).

BRACHYURA PRIMIGENIA OR DROMIACEA [12]

[12] Boas is of the opinion that the Dromiacea are Brachyura, and Bouvier, that they connect the higher Brachyura with the homarid family of Macrura. The opinion adopted here is that of Alcock, who adopted the view of Boas and subdivided it into natural groups: Homolidea and Dromidea with corresponding families:

Homolidea—
1. Momolidæ
2. Latreillidæ

Dromidea—
1. Homolodromidæ
2. Dynomidæ
3. Dromidæ

Tribe HOMOLIDEA

LATREILLIDÆ

Genus LATREILLOPSIS Henderson

LATREILLOPSIS BISPINOSA Henderson.

Latreillopsis bispinosa HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 22, pl. 2, fig. 3; ALCOCK, Carc. Faun. India. Journ. Asiat. Soc. Bengal 68 (1899) 166.

CEBU (Challenger), 95 fathoms, blue mud bottom.

Genus LATREILLA Roux

LATREILLA VALIDA de Haan.

Latreilla valida DE HAAN, Faun. Japon. Crust. (1839) 407, pl. 30, fig. 1; HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 24; RATHBUN, Proc. U. S. N. M. 26 : 32.

CEBU, 95 fathoms, blue mud bottom (Challenger).

Tribe DROMIDEA

DROMIDÆ

Genus DROMIA Fabricius

DROMIA (CRYPTODROMIA) TUBERCULATA Stimpson.

Dromia (Cryptodromia) tuberculata ALCOCK, Carc. Faun. India. Journ. Asiat. Soc. Bengal 68 (1899) 141.

MINDORO, Mindoro Province, Puerto Galera, 0–270. PABELLONES, 0–1098. LUZON, Bataan Province, Mariveles, 0367.

Genus CRYPTODROMIA Stimpson

CRYPTODROMIA LATERALIS (Gray).

Dromia verrucosipes WHITE, List Crust. Brit. Mus. (1847) 55.

Cryptodromia lateralis HENDERSON, Rept. Voy. Challenger, Zoöl. 27 (1888) 5.

Philippines (Challenger).

Tribe OXYSTOMATA

Family RANINIDÆ Dana

Genus RANINA Lamarck

RANINA DENTATA Latreille.

Ranina dentata VON SIEBOLD, Faun. Japon. Crust. (1839) 139, pl. 35, fig. 1.

MINDANAO, Zamboanga Province. PINGET, Puro. LUZON, Ilocos Sur Province, Lapog Bay. These crabs inhabit the sandy bottom where they lie buried, like many of the Leucosidæ and Calappidæ. In Zamboanga, where these crabs are caught in considerable numbers, they are considered a delicacy, and are commonly sold in the markets.

Carcinologists differ as to the systematic position of this group. Lamarck[13] arranged *Ranina* with Hippidæ in a distinct section of the family characterized by the lamellated terminal joints of the legs. Henderson[14] recognized the tribe Raninidea of Dana and placed it under Anomura, while Boas placed it with the Brachyura. Miers[15] wrote: "I believe their (Hippidæ) true affinities are with the Oxystomatous Brachyura through the Raninidæ." Alcock considered the Raninidæ as lowest among the oxystomatous crabs.

Suborder BRACHYURA

Tribe OXYSTOMATA or LEUCOSIIDEA

LEUCOSIDÆ

Subfamily LEUCOSINÆ Miers

Genus LEUCOSIA Fabricius

LEUCOSIA HASWELLI Miers.

Leucosia haswelli MIERS, Rept. Voy. Challenger Brachyura 17 (1886) 324, pl. 27, fig. 2; NOBILI, Ann. Mus. Civ. St. Nat. Genova (2) 20 (1899) 251; CALMAN, Trans. Linn. Soc. (2) 8 (1900) 27; IHLE, Siboga Exped. 85 (1918) 276.

PALAWAN, Taytay, 0–1207. MINDORO, Mindoro Province, Puerto Galera, 0–1813. SULU (Siboga).

LEUCOSIA AUSTRALIENSIS Miers.

Leucosia australiensis MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 322, pl. 27, fig. 1.

MINDORO, Mindoro Province, Puerto Galera, 0–1402.

LEUCOSIA CRANIOLARIS (Linnæus).

? *Cancer craniolaris* LINNÆUS, Mus. Lud. Ulricae (1764) 431; HERBST, Naturgesch. Krabben u. Krebse 1 (1782) 90, pl. 2, fig. 17.

Leucosia craniolaris FABRICIUS, Entom. Syst. Suppl. (1798) 350; MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 122; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 325.

MINDORO, Mindoro Province, Puerto Galera, 0–1812. LUZON, Manila Bay, 0218.

LEUCOSIA CUMINGI Bell.

Leucosia cumingi BELL, Trans. Linn. Soc. London 21 (1853) 290, pl. 31, fig. 3; IHLE, Decapoda Siboga Exped. Brachyura 85 (1918) 285.

Philippines (Siboga).

LEUCOSIA PUNCTATA Bell.

Leucosia punctata BELL, Trans. Linn. Soc. London 21 (1855) 286, pl. 30, fig. 5; IHLE, Decapoda, Siboga Exped. Brachyura 85 (1918) 277.

[13] Hist. Nat. Animaux san Vert. 5 (1818) 218.

[14] Challenger Rept. 27 (1888).

[15] Revision of the Hippidea. Journ. Linn. Soc. Zoöl. 14.

Leucosia affinis BELL, Trans. Linn. Soc. London **21** (1855) 287, pl. 30, fig. 6.

Philippines (Siboga).

LEUCOSIA BREVIMANA Bell.

Leucosia brevimana BELL, Trans. Linn. Soc. London **21** (1855) 288, pl. 30, fig. 7; IHLE, Decapoda, Siboga Exped. Brachyura **85** (1918) 315.

Philippines (Siboga).

LEUCOSIA MARMOREA Bell.

Leucosia marmorea IHLE, Decapoda, Siboga Exped. Brachyura **85** (1918) 316.

Philippines (Siboga).

LEUCOSIA PERLATA de Haan.

Leucosia perlata DE HAAN, Faun. Japon. (1850) 134; DE MAN, Notes Leyden Mus. **3** (1881) 124; ORTMANN, Decapod. Krebse, Strassburger Mus. Zoöl. Jahrb. Syst. **6** (1892) 584.

Leucosia pallida BELL, Trans. Linn. Soc. London **21** (1855) 283.

Leucosia parvimana STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 150.

Philippines (Bell).

Genus PHILYRA Leach

PHILYRA PLATYCHEIR de Haan.

Philyra platycheir DE HAAN, Faun. Japon. Crust. (1841) 132.

Philyra platycheira BELL, Trans. Linn. Soc. London **21** (1855) 300; DE MAN, Journ. Linn. Soc. London **22** (1888) 201.

MINDORO, Mindoro Province, Puerto Galera, 0–1853, 0–1811.

Genus PSEUDOPHILYRA Miers

PSEUDOPHILYRA WOOD-MASONI Alcock.

Pseudophilyra wood-masoni ALCOCK and ANDERSON, III, Zoöl. Investigator, Crust. (1897) pl. 30, fig. 6; IHLE, Decapoda, Siboga Exped. **85** (1918) 269.

Sulu Sea (Siboga).

Genus CRYPTOCNEMUS Stimpson

CRYPTOCNEMUS MACROGNATHUS Ihle.

Cryptocnemus macrognathus IHLE, Tijdschr. Ned. Dierk. Ver. (2) **14** (1915) 60; IHLE, Decapod. Siboga Exped. **85** (1918) 292, fig. 148.

North Ubian, 6° 7.5′ north latitude, 120° 26′ 0″ east longitude (Siboga).

ILLINÆ

Genus MYRA Leach

MYRA FUGAX (Fabricius).

Leucosia fugax FABRICIUS, Entom. Suppl. (1798) 351.

Myra fugax LEACH, Zoöl. Miscell. **3** (1817) 24; MILNE EDWARDS, Hist. Nat. Crust. **2** (1837) 126; DE HAAN, Faun. Japon. Crust. (1841)

134, pl. 33, fig. 1; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 313.

Myra carinata BELL, Trans. Linn. Soc. London (1855) 297, pl. 32, fig. 3.

LUZON, Ilocos Sur Province. MINDORO, sandy bottom. The specimens are in the collection of The Northern Luzon Junior College.

MYRA PUNCTATA Herbst.

Myra punctata HERBST, Krabben u. Krebse 1 (1782) 89, pl. 2, figs. 15, 16; DE MAN, Journ. Linn. Soc. London 22 (1888) 205.

Philippines (Siboga).

MYRA DARNLEYENSIS Haswell.

Myra darnleyensis HASWELL, Proc. Linn. Soc. N. S. W. 4 (1880) 52, pl. 5, fig. 4; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 315.

Myra kesileri IHLE, Decapod. Siboga Exped. III 85 (1918) 260.

Dredged from Celebes Sea, south of Mindanao, 6° 54′ 0″ north latitude, 122° 18′ 0″ east longitude, 10 fathoms (Challenger).

Genus MYRODES Bell

MYRODES EUDACTYLUS Bell.

Mirodes eudactylus BELL, Trans. Linn. Soc. London 21 (1855) 229, pl. 32, fig. 6; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 298; IHLE, Decapoda, Siboga Exped. 85 (1918) 262.

Myra eudactyla A. M. EDWARDS, Nouv. Archiv. Mus. Paris 10 (1874) 46, pl. 3, fig. 3.

Myrodes gigas HASWELL, Proc. Linn. Soc. N. S. Wales 4 (1879) 52, pl. 5, fig. 5.

Philippines (Bell).

Genus IXA Leach

IXA CYLINDRICUS var. MEGASPIS Adams and White.

Ixa cylindricus var. *megaspis* ADAMS and WHITE, Crust. (1848) 55, pl. 12, fig. 1; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 301; IHLE, Decapoda, Siboga Exped. 85 (1918) 285.

BOHOL (Samarang); N–334, locality not indicated.

Genus IPHICULUS Adams and White

IPHICULUS SPONGIOSUS Adams and White.

Iphiculus spongiosus ADAMS and WHITE, Samarang Crust. (1848) 57, pl. 13, fig. 5; LANCHESTER, Proc. Zoöl. Soc. London (1900) 766; STIMPSON, Smith, Misc. Coll. 49 (1907) 159, pl. 18, fig. 8; IHLE, Decapoda, Siboga Exped. 85 (1918) 252.

Philippines (Samarang).

Genus ARCANIA Leach

ARCANIA NOVEMSPINOSA (Adams and White).

Iphis novemspinosa ADAMS and WHITE, Crust. Samarang (1848) 56, pl. 13, fig. 1.

Arcania novemspinosa IHLE, Decapoda, Siboga Exped. 85 (1918) 265.

MINDORO (Siboga).

ARCANIA UNDECIMSPINOSA de Haan.

Arcania undecimspinosa DE HAAN, Faun. Japon. Crust. (1841) 125, pl. 33, fig. 8; IHLE, Decapoda, Siboga Exped. 85 (1918) 265.

Arcania granulosa MIERS, Trans. Linn. Soc. London (2) 1 (1877) 240, pl. 38, fig. 29.

Sulu Sea (Siboga).

Genus HETEROLITHADIA Wood-Mason

HETEROLITHADIA FALLAX (Henderson).

Ebalia fallax HENDERSON, Trans. Linn. Soc. London (2) 5 (1893) 402, pl. 38, figs. 4–6.

Heterolithadia fallax LAURIE, Rept. Pearl-Oyster Fish., Brachyura (1906) 365; IHLE, Decapoda, Siboga Exped. 85 (1918) 254.

Sulu Sea (Siboga).

Subfamily EBALINÆ Stimpson

Genus OREOPHORUS Ruppell

(= *Tlos* Adams and White)

OREOPHORUS (OREOTLOS) ANGULATUS (Rathbun).

Tlos angulatus RATHBUN, U. S. Fish Comm. Bul. (1903) 889, fig. 42; pl. 16, fig. 5.

Oreophorus (*Oreotlos*) *angulatus* IHLE, Decapoda, Siboga Exped. 85 (1918) 216.

Sulu Archipelago, TONGKIL (Siboga).

Family DORIPPIDÆ Dana

Genus DORIPPE Fabricius

DORIPPE QUADRIDENS Fabricius.[16]

Dorippe quadridens FABRICIUS, Suppl. Ent. (1798) 361; DE HAAN, Faun. Japon. Crust. (1841) 121; DE MAN, Journ. Linn. Soc. London 22 (1888) 206.

MINDORO, Mindoro Province, Puerto Galera, 0–57, 0–1849. CEBU.

Genus ETHUSA Roux

ETHUSA (ETHUSINA) GRACILIPES Miers.

Ethusa gracilipes MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 332, pl. 29, fig. 1.

Dredged from a depth of 700 fathoms in 12° 21′ north latitude, 122° 15′ 0″ east longitude.

[16] These crabs are usually found hooked under the umbrella of a jellyfish belonging to the Genus *Cassiopea*. The last pair of the legs are placed farther on the dorsal side and are modified for hooking.

CALAPPIDÆ

Subfamily CALAPPINÆ Dana

Genus CALAPPA Fabricius

CALAPPA GALLUS (Herbst).

Gallus gallus DE HAAN, Crust. Faun. Japon. (1837) 70.

Calappa gallus DANA, U. S. Explor. Exped. Crust. **13** (1852) 393; MIERS, Rept. Voy. Challenger, Brachyura **17** (1886) 286; RATHBUN, Trans. Linn. Soc. London (2) **14** (1911) 197; IHLE, Decapod. Siboga Exped. **85** (1918) 181.

Calappa galloides STIMPSON, Ann. Lyc. Nat. Hist. New York **7** (1859) 71, var.

LUZON, Bataan Province, Mariveles, 0171.

CALAPPA PHILARGICUS (Linnæus).

Calappa cristata M. EDWARDS, Hist. Nat. Crust. **2** (1837) 105, pl. 20, figs. 1, 2.

Calappa philargicus NOBILI, Ann. Mus. Civ. St. Nat. Genova (2) **20** (1899) 249; IHLE, Decapoda, Brachyura, Siboga Exped. **85** (1918) 183.

BOHOL, Bohol Province, Inabanga, 0172. LUZON, Cagayan Province, Aparri, 0173. NEGROS, Negros Occidental Province, Sicaba, Cadiz Nuevo, 0228.

CALAPPA HEPATICA (Linnæus).

Calappa tuberculata DANA, U. S. Explor. Exped. **22** (1852) 393; A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. **10** (1874) 55.

Calappa hepatica HERKLOTS, Symbalae Carcin. (1861) 25; MIERS, Rept. Voy. Challenger, Brachyura **17** (1886) 285; BORRADAILE, Faun. Geog. Maldive and Laccad. Archipelago, pt. 4 **1** (1903) 456; IHLE, Decapoda, Siboga Exped. **85** (1918) 183.

SULU, Sitankay, 0176. BASUM, Sulu Province, 0178. LUZON, Tayabas Province, Polillo, 0181. Sulu Archipelago, Sanguisiapo (Siboga); 0–1268, locality not indicated.

MATUTIDÆ

Genus MATUTA Fabricius

MATUTA VICTRIX Fabricius.

Matuta victor FABRICIUS, Entom. Syst. Suppl. (1798) 369; M. EDWARDS, Hist. Nat. Crust. **2** (1837) 115, pl. 20, figs. 3–6.

Matuta victrix MIERS, Trans. Linn. Soc. (2) **1** (1877) 243, pl. 39, figs. 1–3; Rept. Voy. Challenger, Brachyura **17** (1886) 295.

PALAWAN, Iwahig, 0–25. LUZON, Manila Bay, 0185. MINDORO, Mindoro Province, Calapan, 0187. NEGROS, Occidental Negros Province, Sicaba, Cadiz Nuevo, 0227. MINDANAO, Zamboanga Province (Challenger), 10 to 20 fathoms.

MATUTA BANKSII Leach.

Matuta banksii MIERS, Trans. Linn. Soc. (2) **1** (1877) 245, pl. 40, figs. 1, 2; MIERS, Rept. Voy. Challenger, Brachyura **17** (1886) 295;

BORRADAILE, Faun. Geog. Maldive and Laccad. Archipel. pt. 4 1 (1903) 436; IHLE, Decapoda, Siboga Exped. 85 (1918) 185.

Matuta picta MIERS, Trans. Linn. Soc. (2) 1 (1877) 246, pl. 40, figs. 5–7.

Matuta obtusifrons **MIERS, Trans. Linn. Soc.** (2) 1 (1877) 247.

PALAWAN, Iwahig, 0–339. LEYTE, Leyte Province, Dulag, 0183. BANTAYAN, Cebu Province, 0184. MINDANAO, Zamboanga (Challenger), 10 fathoms.

MATUTA LUNARIS (Forskål).

Matuta maculata MIERS, Trans. Linn. Soc. (2) 1 (1877) 246, pl. 40, figs. 3, 4.

Matuta victrix + *maculata* DE MAN, Notes Leyden Mus. 3 (1881) 110, 116.

Matuta victrix + *crebrepunctata* DE MAN, Weber's Zoöl. Ergebn. einer Reise in Niederl. Ost-Indien 2 (1892) 351.

Matuta lunaris STEBBING, Mar. Invert. S. Africa 4 (1905) 54; LAURIE, Brachyura, Rept. Pearl-Oyster Fish. 5 (1906) 356; IHLE, Decapoda, Siboga Exped. 85 (1918) 185.

LUZON, Rizal Province, Pasay, 0186. NEGROS, Occidental Negros Province, Cadiz Nuevo, 0226.

Tribe CYCLOMETOPA or CANCROIDEA [17]

CORYSTIDÆ

(Euryalidæ Rathbun)

Genus GOMEZA Gray

GOMEZA BICORNIS Gray.

Gomeza bicornis GRAY, Zoöl. Miscell. (1831) 39; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 212.

Corystes (*Eidea*) *vigintispinosa* DE HAAN, in v. Siebold, Fauna Japon. (1835) 44, pl. 2, fig. 5.

Gomeza vigintispinosa A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 10 (1874) 52, pl. 3, fig. 5.

CEBU, 0–1774. MINDORO, Mindoro Province, Puerto Galera. The Challenger specimen was collected south of MINDANAO in 6° 54′ 0″ north latitude 122° 18′ 0″ east longitude from a depth of 10 fathoms.

[17] Alcock divided this tribe into five families, and arranged them in the descending order as follows:

1. Telphusidæ (Potamonidæ of other authors)
2. Xanthidæ
3. Portunidæ
4. Cancridæ
5. Corystidæ.

According to him, the Corystidæ are the lowest Cyclometops and have the same relative position to the higher families of the tribe as the Ranidæ have to the higher families of the tribe Oxystomata.

According to Rathbun, the family should be Euryalidæ, because the genus from which it was established, *Euryala* Weber, 1793, takes precedence of *Corystes* Latreille, 1802, both having the same type. Proc. Biol. Soc. Wash. 17 (1904) 17.

PORTUNIDÆ [18]

Subfamily LUPINÆ Alcock

(= Thalamitinæ Rathbun)

Genus CHARYBDIS de Haan

(= *Goniosoma* A. M. Edwards)

CHARYBDIS (GONIOSOMA) MILES (de Haan).

Portunus (*Charybdis*) *miles* DE HAAN, Fauna Japon Crust. p. 41, pl. 11, fig. 1.

Goniosoma miles A. M. EDWARDS, Archiv. du Mus. **10** (1861) 378.

Charybdis (*Goniosoma*) *miles* ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 62.

PALAWAN, Taytay, 0–1445.

CHARYBDIS (GONIOSOMA) NATATOR (Herbst).

Cancer natator HERBST, Krabben II **5** (1796) 156, pl. 40, fig. 1.

Goniosoma natator A. M. EDWARDS, Archiv. du Mus. **10** (1861) 370, 385.

Charybdis (*Goniosoma*) *natator* ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 61.

PALAWAN, Taytay, 0–1443. LUZON, Sorsogon Province, Bulan, 0120. MINDORO, Mindoro Province, Calapan, 0262.

CHARYBDIS RIVERS-ANDERSONI Alcock.

Charybdis (*Goniosoma*) *rivers-andersoni* ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 53.

PALAWAN, Taytay, 0–1766. LUZON, Bataan Province, Mariveles, 0–457.

CHARYBDIS (GONIOSOMA) CRUCIFERA (Fabricius).

Cancer sexdentatus HERBST, Krabben (1790), pl. 7, fig. 53.

Portunus crucifer FABRICIUS, Ent. Syst. Suppl. (1798) 364.

Charybdis crucifera DANA, U. S. Explor. Exped. Crust. **1** (1852) 286, pl. 17, fig. 11*a–c*; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 51.

Goniosoma crucifera A. M. EDWARDS, Archiv. du Mus. **10** (1861) 371, 385.

PALAWAN, Taytay, 0–1237. LUZON, Rizal Province, Malabon, 0121; Ilocos Sur Province; Ilocos Norte Province.

CHARYBDIS (GONIOSOMA) MERGUIENSIS (de Man).

Goniosoma merguiensis DE MAN, Journ. Linn. Soc. Zoöl. **22** (1887–88) 82, pl. 5, figs. 3, 4.

Goniosoma helleri HENDERSON, Trans. Linn. Soc. Zoöl. (2) **5** (1893) 375.

[18] Alcock divided this family into four subfamilies: Carcininæ, Portuninæ, Caphyrinæ, and Lupinæ. "The Carcininæ by way of Carcinus approach the Xanthidæ by way of Hoploxanthus."

Charybdis (Goniosoma) merguiensis ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 54.

MINDORO, Mindoro Province, Puerto Galera, 0–1788; Calapan, 0232. SAMAR, Samar Province, Catbalogan, 0123. LUZON, Rizal Province, Malabon, 0124; Manila, Farola, 0125. NEGROS, Occidental Negros Province, Sicaba, 0247.

CHARYBDIS (GONIOSOMA) ANISODON (de Haan).

Goniosoma anisodon A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris 9 (1873) 167; ORTMANN, Zoöl. Jahrb. Syst. 7 (1894) 83.

Bought from the markets in Manila, 0–32. This species is considered one of the conspicuous links between *Charybdis* and *Thalamita*.

CHARYBDIS (GONIOHELLENUS) ORNATA A. M. Edwards.

Thalamita truncata DE HAAN, Faun. Japon. Crust. p. 43, pl. 2, fig. 3.
Charybdis truncata STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 39.
Goniosoma ornatum A. M. EDWARDS, Archiv. du Mus. 10 (1861) 376.
Charybdis (Goniohellenus) ornata ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 64.

LUZON, Bataan Province, Mariveles, 0234.

Genus THALAMITA Latreille, A. M. Edwards

THALAMITA STIMPSONI A. M. Edwards.

Thalamita stimpsoni A. M. EDWARDS, Archiv. du Mus. 10 (1861) 362, pl. 35, fig. 4; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 198; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 79.

MINDORO, Mindoro Province, Puerto Galera, 0–1713, 0–1789. MINDANAO, Zamboanga Province (Challenger), from a reef at a depth of 10 fathoms.

THALAMITA WOOD-MASONI Alcock.

Thalamita wood-masoni ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 90.

MINDORO, Mindoro Province, Puerto Galera, 0–1797.

THALAMITA INVESTIGATORIS Alcock.

Thalamita investigatoris ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 85.

MINDORO, Mindoro Province, Puerto Galera, 0–1784.

THALAMITA ADMETA (Herbst).

Cancer admeta HERBST, Krabben, III 3 : 40, pl. 58, fig. 1.
Thalamita savignyi A. M. EDWARDS, Archiv. du Mus. 10 (1861) 357; HENDERSON, Trans. Linn. Soc. Zoöl. (2) 5 (1893) 372.
Thalamita admeta ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 82.

PALAWAN, Taytay, 0–1776. MINDORO, Mindoro Province, Calapan, 0156. NEGROS, Occidental Negros Province, Sicaba, Cadiz Nuevo, 0241.

THALAMITA DANÆ Stimpson.

Thalamita crenata DANA, U. S. Explor. Exped. Crust. 1 (1852) 282, pl. 17, figs. 7*a–b*.

Thalamita danæ STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 39; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 77.

PALAWAN, Taytay, 0–1446. MINDORO, Mindoro Province, Calapan, 0150. LEYTE, Leyte Province, Polillo, 0153. BANTAYAN, Cebu Province, 0155.

THALAMITA CRENATA (Latreille).

Talamita prymna var. *crenata* RICHTERS, in Mobius Meereaf Maurit. p. 153.

Thalamita crenata DE MAN, Journ. Linn. Soc. London 22 (1888) 79; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 76.

JOLO, 0–1557. SAMAR, Samar Province, Borongan, 0–136. PANAY, Capiz Province, Iloilo Province, 0147; Barotac Nuevo, 0146. NEGROS, Oriental Negros Province, Tanjay, 0148.

THALAMITA PRYMNA (Herbst).

Cancer prymna HERBST, Krabben, III 3 : 41, pl. 52, fig. 2.

Thalamita crassimana DANA, Proc. Acad. Nat. Sci. Philad. (1852) 85; STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858–59) 39.

Thalamita prymna M. EDWARDS, Hist. Nat. Crust. 1 : 461; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 78.

MINDANAO, Apo Reef, 0–453. LUZON, Cavite Province, 0–972. MINDORO, Mindoro Province, Calapan, 0153. NEGROS, Occidental Negros Province, Cadiz Nuevo, Sicaba, 0242.

THALAMITA INTEGRA Dana.

Thalamita integra DANA, Proc. Acad. Nat. Sci. Philad. 6 (1852) 85; HENDERSON, Trans. Linn. Soc. Zoöl. (2) 5 (1893) 373; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 85.

NEGROS, Occidental Negros Province, Cadiz Nuevo, Sicaba, 0244.

THALAMITA SPINIMANA Dana.

Thalamita spinimana DANA, U. S. Explor. Exped. Crust. 1 (1852) 283, pl. 17, fig. 8; A. M. EDWARDS, Archiv. du Mus. Hist. Nat. 10 (1861) 364; DE MAN, Journ. Linn. Soc. London 22 (1888) 76, pl. 4, fig. 7.

MINDORO, Mindoro Province, Calapan, 0154. MACTAN, Cebu Province, 0160.

Genus THALAMITOIDES A. M. Edwards

THALAMITOIDES TRIDENS A. M. Edwards.

Thalamitoides tridens A. M. EDWARDS, Nouv. Archiv. Mus. Nat. Hist. Paris 5 (1869) 149, pl. 6, figs. 1–7; DE MAN, Notes Leyden Mus. 3 (1881) 99; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. 7 (1894).

Hedrophthalmus thalamitoides NAUCK, Zeitschr. f. Wiss. Zool. 34 (1880).

Philippines (Nauck).

Genus NEPTUNUS de Haan

NEPTUNUS PELAGICUS Linnæus.

Neptunus pelagicus DE HAAN, Faun. Japon. Crust. p. 37, pls. 9, 10; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 34.

Portunus cedo-nuli BOSC, Hist. Nat. Crust. **1**: 221.

LUZON, Cavite Province, San Roque, 0–1759; Manila Bay, 0–1770; Rizal Province, Malabon, 0128. PANAY, Iloilo Province, Molo, 0131; Dumangas, 0132. BANTAYAN, Cebu Province, 0134. JOLO, Sulu Province, Sitankay, 0127.

One of the most common crabs sold in Philippine markets.

NEPTUNUS SANGUINOLENTUS (Herbst).

Cancer sanguinolentus HERBST, Krabben **1** (1790) 161, pl. 8, figs. 56, 57.

Cancer pelagicus FABRICIUS, Mant. Ins. **1** : 318.

Neptunus sanguinolentus DE HAAN, Fauna Japon. Crust. p. 38; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 32.

LUZON, Camarines Sur Province, Lake Buhi, 0135. BOHOL, Inabanga, 0136.

NEPTUNUS (ACHELOUS) ORBICULARIS Richters.

Achelous orbicularis RICHTERS, in Mobius, Meerest. Maurit. p. 153, pl. 16, figs. 14, 15; HENDERSON, Trans. Linn. Soc. Zoöl. (2) **5** (1893) 371.

Neptunus (*Achelous*) *orbicularis* ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 47.

MINDORO, Mindoro Province, Puerto Galera, 0–549. JOLO, 0–1769.

NEPTUNUS (HELLENUS) HASTATOIDES (Fabricius).

Portunus hastatoides FABRICIUS, Ent. Syst. Suppl. p. 368.

Amphitrite hastatoides DE HAAN, Faun. Japon. Crust. p. 39, pl. 1, fig. 2.

Cancer hastatus HERBST, Krabben, III **3** : 3, pl. 55, fig. 1.

Neptunus (*Hellenus*) *hastatoides* ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal **68** (1899) 38.

LUZON, Bataan Province, Mariveles, 0235.

NEPTUNUS XANTHUSII (Stimpson).

Achelous xanthusii STIMPSON, Ann. Lyc. Nat. Hist. New York **7** (1860) 222, pl. 39, fig. 1; HOLMES, Occas. Papers Cal. Acad. Sci. **7** (1900) 71.

MINDORO, Mindoro Province, Puerto Galera, 0–196.

NEPTUNUS (AMPHITRITE) RUGOSUS A. M. Edwards.

Neptunus rugosus A. M. EDWARDS, Archiv. Mus. Hist. Nat. **10** (1861) 335, pl. 33, fig. 3.

Neptunus (*Amphitrite*) *rugosus* MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. **17** (1886) 176.

Dredged during the Challenger Expedition in 11° 37′ 0″ north latitude, 123° 31′ 0″ east longitude, 18 fathoms, blue mud bottom.

NEPTUNUS (AMPHITRITE) SPINIPES Miers.

Neptunus (Amphitrite) spinipes MIERS, Rept. Voy. Challenger Brachyura, Zoöl. 17 (1886) 175.

Neptunus (Hellenus) spinipes ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 39.

Dredged 11° 37′ 0″ north latitude, 123° 21′ 0″ east longitude, 18 fathoms, blue mud bottom (Challenger).

NEPTUNUS (ACHELOUS) GRANULATUS (Milne Edwards).

Lupa granulata M. EDWARDS, Hist. Nat. Crust. 1 (1834) 454.

Portunus (Amphitrite) gladiator DE HAAN (not Fabr.), Crust. v. Siebold, Faun. Japon. (1837) 65, pl. 18, fig. 1.

Achelous granulatus A. M. EDWARDS, Archiv. Mus. Hist. Nat. 10 (1861) 344.

Neptunus (Achelous) granulatus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 180; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 72.

CEBU (Thallwitz); MINDANAO, Zamboanga Province (Challenger), 10 fathoms.

NEPTUNUS (AMPHITRITE) TENUIPES de Haan.

Neptunus (Amphitrite) tenuipes HASWELL, Cat. Austral. Crust. (1882) 83; THALLWITZ, Abh. Mus. Dresden (1891) 3, pl. 48; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 74.

CEBU (Thallwitz).

NEPTUNUS (NEPTUNUS) PELAGICUS var. TRITUBERCULATUS Miers.

Neptunus (Neptunus) pelagicus var. *trituberculatus* MIERS, Ann. Nat. Hist. (4) 17 (1876) 221; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 74.

Philippines (Challenger); Manila (Heller).

Genus SCYLLA de Haan

SCYLLA SERRATA (Forskål).

Cancer serratus FORSKÅL, Descript. Anim. p. 90.

Scylla serrata DE HAAN, Faun. Japon. Crust. p. 44; STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 38; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 68 (1899) 27.

Scylla tranquebarica DANA, U. S. Explor. Exped. Crust. 1 (1852) 270.

MINDORO, Mindoro Province, Puerto Galera, 0–1312. PALAWAN, Taytay, 0–1102. LUZON, Manila Bay, 0140; Cagayan Province, Aparri, 0143; Camarines Sur Province, Calabanga, 0145. PANAY, Iloilo Province, Dumangas, 0144.

These crabs grow to considerable size and constitute the most valuable edible species. They are widely distributed, but abound especially in places where there are extensive mangrove swamps.

CARCININÆ

Genus LISSOCARCINUS Adams and White

LISSOCARCINUS LÆVIS Miers.

Lissocarcinus lævis MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 205, pl. 17, fig. 3.

Dredged south of MINDANAO, at 6° 54′ 0″ north latitude, 122° 18′ 0″ east longitude, 10 fathoms.

LISSOCARCINUS BOHOLENSIS Semper (ined.) and Nauck.

Lissocarcinus boholensis MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 206.

Philippines, possibly BOHOL.

PODOPHTHALMINÆ [19]

Genus PODOPHTHALMUS Lamarck

PODOPHTHALMUS VIGIL (Fabricius).

Portunus vigil FABRICIUS, Entom. Syst. Suppl. (1798) 363.

Podophthalmus vigil LEACH, Zoöl. Miscell. 2 (1815) 149, pl. 116; A. M. EDWARDS, Archiv. Mus. Hist. Nat. 10 (1861) 420; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 207; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 87.

BANTAYAN, Cebu Province, Hagnaya, 0138.
Occasionally sold in Manila markets.

XANTHIDÆ [20]

XANTHINÆ

Alliance CARPILOIDEA

Genus CARPILIUS Leach, Desmarest, A. M. Edwards

CARPILIUS MACULATUS Linnæus.

Cancer maculatus LINNÆUS, Syst. Nat. 12 : 1042.

Cancer rubber RUMPHIUS, Amboinische Rariteitkamer, p. 18, pl. 10, fig. 1.

Carpilius maculatus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 111; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 79.

[19] Some authors placed the Podophthalminæ as a subfamily under Portunidæ, while others, like Ortmann, recognized it as distinct.

[20] This family is divided into seven subfamilies:

1. Actaginæ,	4. Menippinæ,
2. Chlorodinæ,	6. Pilimninæ,
3. Xanthinæ,	5. Oziinæ,
	7. Eriphiinæ.

MINDORO, Mindoro Province, Puerto Galera, 0–1642; Calapan, 0097. LUZON, Ilocos Sur Province; Ilocos Norte Province.

Widely distributed in the Philippines, commonly found in rocky bottom.

CARPILIUS CONVEXUS (Forskål).

Cancer convexus FORSKÅL, Descript. Anim. p. 88.

Cancer adspersus HERBST, Krabben 1 (1790) 264, pl. 21, fig. 1.

Carpilius convexus RUPPELL, 24 Krabben roth. Meer. p. 13, pl. 3, fig. 2; pl. 6, fig. 6; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 80.

MINDORO, Mindoro Province, Calapan, 0096. SILONAY, 0–1532. LUZON, Ilocos Sur Province; Ilocos Norte Province.

Of wide distribution.

Genus CARPILODES Dana, A. M. Edwards

CARPILODES BELLUS (Dana).

Actæodes bellus DANA, Proc. Acad. Nat. Sci. Philad. (1852) 78; U. S. Explor. Exped. Crust. 13 (1852) 196, pl. 11, fig. 2.

Actæa bella A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 1 (1865) 261.

Carpilodes bellus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 134.

MINDANAO, from the beach at Zamboanga Province (Challenger).

Genus LIOMERA Dana

LIOMERA CINCTIMANA (White).

Carpilius cinctimanus WHITE, in Jukes' Voy. H. M. S. "Fly" 2: 336, pl. 2, fig. 3.

Liomera cinctimana DANA, Silliman's Journ. (2) (1851) 75; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 88.

Carpilodes cinctimanus MIERS, Ann. Mag. Nat. Hist. (5) 5 (1880) 234.

MINDORO, Mindoro Province, Puerto Galera, 0–166.

Alliance ZOZYMOIDEA

Genus LOPHOZOZYMUS A. M. Edwards

LOPHOZOZYMUS OCTODENTATUS (M. Edwards).

Xantho octodentatus M. EDWARDS, Hist. Nat. Crust. 1: 398.

Cancer saxatilis RUMPHIUS, Amboinische Rariteitk. pl. 9; pl. 5, fig. *m.*

Lophozozymus octodentatus ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 106.

PALAWAN, Taytay, 0–1050.

Genus LOPHACTEA A. M. Edwards

LOPHACTEA GRANULOSA (Ruppell).

Xantho granulosus RUPPELL, 24 Krabben roth. Meer. p. 24, pl. 5, fig. 3.

Ægle granulosus DE HAAN, Faun. Japon. Crust. p. 17 (name only).

Atergatis limbatus DANA, U. S. Explor. Exped. Crust. pt. 1 (1852) 157.

Lophactea granulosa ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 459; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 101.

BANTAYAN, Cebu Province, 0–244. Sulu Sea (Dana).

Genus LOPHOPANOPEUS Rathbun

LOPHOPANOPEUS BELLUS (Stimpson).

Xantho bella STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1860) 204, pl. 3, fig. 2.

Xanthodes hemphilii LOCKINGTON, Proc. Calif. Acad. Sci. 7 (1876) 32.

Lophoxanthus bellus A. M. EDWARDS, Crust. Reg. Mex. (1879) 257 (part), pl. 46, figs. 4–4*c*.

Lophozozymus (*Lophoxanthus*) *bellus* MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 115.

Lophopanopeus bellus RATHBUN, U. S. N. M. Bul. 152 (1930) 320, pls. 150–151.

The tag number is badly eaten up, and the place is not indicated.

LOPHOPANOPEUS FRONTALIS (Rathbun).

Lophozozymus (*Lophoxanthus*) *frontalis* RATHBUN, Proc. U. S. N. M. 16 (1893) 236.

Lophoxanthus frontalis HOLMES, Occas. Papers California Acad. Sci. 7 (1900) 64, pl. 1, figs. 5, 6.

Lophopanopeus frontalis RATHBUN, U. S. N. M. Bul. 152 (1930) 323, pl. 152.

PALAWAN, Taytay, 0–1024.

Genus ATERGATOPSIS A. M. Edwards

ATERGATOPSIS SIGNATA (Adams and White).

Carpilius signatus ADAMS and WHITE, Zoöl. Voy. "Samarang" Crust. (1848), pl. 10, fig. 1.

Atergatopsis signatus A. M. EDWARDS, Nouv. Archiv. Mus. Paris, Hist. Nat. 1 (1866) 253; RATHBUN, Marine Brachyura, Trans. Linn. Soc. London, Zoöl. 14: 214.

PABELLONES, Mindoro Province, Puerto Galera, 0–1756.

Genus ATERGATIS de Haan, A. M. Edwards

ATERGATIS FLORIDUS (Rumphius).

Cancer floridus RUMPHIUS, Amboinisch. Rariteitkamer p. 16, pl. 7, fig. 5.

Atergatis floridus DE HAAN, Faun. Japon. Crust. p. 46; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 112; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 98.

POLILLO, Tayabas Province, 0090. DINAGAT, Surigao Province, 0091. SIASI, Sulu Province, 0092. MINDORO, Mindoro Province, Calapan, 0094. CEBU (Challenger), from a reef.

ATERGATIS INTEGERRIMUS var. TYPICA Ortmann.

Cancer integerrimus M. EDWARDS, Hist. Nat. Crust. 1 (1834) 374.

Atergatis subdivisus WHITE, Proc. Zoöl. Soc. London 15 (1847) 224; ADAMS and WHITE, Zoöl. Voy. Samarang (1848) 38, pl. 8, fig. 3.

Atergatis integerrimus DANA, U. S. Explor. Exped. Crust. (1852) 158.

Atergatis integerrimus var. *typica* ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 462.

MINDORO, Mindoro Province, Puerto Galera, 0–1744, Calapan, 0095. NEGROS, Occidental Negros Province, Sicaba, Cadiz Nuevo, 0329.

Alliance XANTHOIDEA

Genus XANTHO Leach

XANTHO (LEPTODIUS) CAVIPES (Dana).

Chlorodius cavipes DANA, Proc. Ann. Nat. Sci. Philad. (1852) 79.

Leptodius cavipes DE MAN, Journ. Linn. Soc. Zoöl. 22 (1887–88) 34.

Xantho (Leptodius) cavipes ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 122.

MINDORO, Mindoro Province, Puerto Galera, 0–1851.

XANTHO (LEPTODIUS) EUGLYPTUS Alcock.

Xantho (Leptodius) euglyptus ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 121.

MINDORO, Mindoro Province, Puerto Galera, 0–166, 0–1778.

XANTHO BIDENTATUS A. M. Edwards.

Xantho bidentatus A. M. EDWARDS, Ann. Soc. Ent. France (4) 7 (1867) 266; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 126, pl. 11, fig. 4; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 67 (1898) 114.

LEYTE, Leyte Province, Cabalian, 0119. MINDANAO, Zamboanga Province (Challenger).

XANTHO (LEPTODIUS) NUDIPES (Dana).

Chlorodius nudipes DANA, Proc. Ann. Nat. Sci. Philad. (1852) 79.

Leptodius nudipes A. M. EDWARDS, Nouv. Archiv. du Mus. 9 (1873) 225.

Xantho exaratus var. *nudipes* ORTMANN, Zoöl. Jahrb. Syst. 7 (1893–94) 447.

Xantho (Leptodius) nudipes ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 121.

SITANKI, Sulu Province, 0105.

XANTHO (LEPTODIUS) EXARATUS (M. Edwards).

Chlorodius exaratus M. EDWARDS, Hist. Nat. Crust. 1 : 402; 4 : 71.

Xantho affinis DE HAAN, Faun. Japon. Crust. p. 48, pl. 13, fig. 8.

Leptodius exaratus A. M. EDWARDS, Nouv. Archiv. du Mus. 4 (1868) 71.

Xantho (Leptodius) exaratus ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99).

BANTAYAN, Cebu Province, 0–6.

XANTHO LAMARCKII Milne Edwards.

Xantho lamarckii MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 391; ORTMANN, Decapod. Krebse Strassburger, Mus. Zoöl. Jahrb. Syst. 7 (1894) 448.

Xantho cultrimanus WHITE, Proc. Zoöl. Soc. London 15 (1847) 225; ADAMS and WHITE, Zoöl. Voy. Samarang Crustacea (1850) 39.

Xanthodes granosomanus DANA, U. S. Explor. Exped. Crust. (1852) 175, pl. 8, fig. 10.

Xanthodes lamarckii A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris 9 (1878) 200, pl. 7, fig. 8.

Philippines (Adams and White).

Genus LEPTODIUS A. M. Edwards

LEPTODIUS EXARATUS var. SANGUINEUS Miers.

Chlorodius sanguineus M. EDWARDS, Hist. Nat. Crust. 1 (1834) 402; DANA, U. S. Explor. Exped. Crust. 13 (1852) 207, pl. 11, fig. 11.

Leptodius exaratus var. *sanguineus* MIERS, Proc. Zoöl. Soc. London (1877) 134, et synonyma; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 138.

From the beach at Zamboanga, MINDANAO (Challenger).

Subfamily ETISINÆ Ortmann

Genus ETISUS Milne Edwards

ETISUS UTILIS Lucas.

Etisus utilis LUCAS, in Jacquinot, Voy. Astralabe, Crust. 3 (1853) 27, pl. 2, fig. 6; A. M. EDWARDS, Nouv. Archiv. Mus. Paris (1873) 233; ALCOCK, Carc. Faun. India, Journ. Asiat. Soc. Bengal 67 (1898–99) 130.

MINDORO, Mindoro Province, Puerto Galera, 0–388.

ETISUS LÆVIMANUS Randall.

Etisus lævimanus RANDALL, Journ. Acad. Nat. Sci. Philad. 8 (1839) 115; DANA, U. S. Explor. Exped. Crust. (1852) 185, pl. 10, fig. 1; HILGENDORF, Mon.-Ber. Ak. Wiss. Berlin (1878) 791; ORTMANN, Zoöl. Jahrb. Syst. 7 (1894) 473.

Philippines (Hilgendorf).

Genus ETISODES Dana

ETISODES ANAGLYPTUS M. Edwards.

Etisus anaglyptus MILNE EDWARDS, Hist. Nat. Crust. (1834) 411; DE MAN, Notes Leyden Mus. 13 (1891) 7.

Etisodes anaglyptus HASWELL, Cat. Austral. (1882) 55; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 471.

Philippines (Miers).

ACTÆINÆ

Genus ACTÆA de Haan, A. M. Edwards

ACTÆA TOMENTOSA (M. Edwards).

Zozymus tomentosus M. EDWARDS, Hist. Nat. Crust. 1 (1834) 385.

Actæa tomentosa H. M. EDWARDS, Nouv. Archiv. du Mus. (1865) 262; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 140.

Actæodes tomentosus DANA, U. S. Explor. Exped. Crust. **1** (1852) 197; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. **17** (1886) 135.

COMIRAN, Palawan, 0089.

ACTÆA SUFFUSCULA Rathbun.

Actæa suffuscula RATHBUN, Trans. Linn. Soc. London, Zool. **14** : 220.

MINDORO, Mindoro Province, Puerto Galera, 0–1138.

ACTÆA HIRSUTISSIMA (Ruppell).

Xantho hirsutussimus RUPPELL, 24 Krabben roth. Meer. p. 26, pl. 5, fig. 6.

Actæa hirsutissima DE HAAN, Faun. Japon. Crust. p. 18; DANA, U. S. Explor. Exped. **1** (1852) 164.

Actæa hirsutissima ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal **67** (1898–99) 144.

COMIRAN, Palawan Province, 0088.

ACTÆA RUPELLII (Krauss).

Ægle ruppellii KRAUSS, Süd-Afrik. Crust. (1843) 28, pl. 1, fig. 1.

Ægle rugata ADAMS and WHITE, Zoöl. Voy. Samarang (1850) 43, pl. 8, fig. 5; MIERS, Ann. Mag. Nat. Hist. (5) **5** (1880) 232.

Actæa ruppellii A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris **1** (1865) 270; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. **7** (1894) 454.

Locality not indicated, 0–839.

CHLORODINÆ

Alliance CHLORODIOIDA

Genus CHLORODIUS A. M. Edwards

CHLORODIUS NIGER (Forskål).

Cancer niger FORSKÅL, Descript. Anim. p. 89.

Chlorodius niger RUPPELL, 24 Krabben roth. Meer. p. 20, pl. 4, fig. 7; pl. 6, fig. 14; DANA, U. S. Explor. Exped. Crust. (1852) 216, pl. 12, fig. 5.

Chlorodius hirtipes WHITE, P. Z. S. (1848) 226; ADAMS and WHITE, Zoöl. Voy. Samarang, Crust. (1848) 40, pl. 11, fig. 4.

COMIRAN, Palawan Province, 0100. SIASI, 0101. Sulu Sea (Dana).

Genus CHLORODOPSIS A. M. Edwards

CHLORODOPSIS PILUMNOIDES (White).

Chlorodius pilumnoides WHITE, P. Z. S. (1847) 226; WHITE, Ann. Mag. Nat. Hist. (2) **2** (1848) 286; ADAMS and WHITE, Zoöl. Voy. Samarang, Crust. (1848) 41, pl. 9, fig. 3.

Chlorodopsis pilumnoides DE MAN, Journ. Linn. Soc. Zoöl. **22** (1887–88) 34; ORTMANN, Zoöl. Jahrb. Syst. **7** (1893–94) 470; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal **67** (1898–99) 167.

COMIRAN, Palawan Province, 0102. Locality not indicated, 0–1755.

Genus PHYMODIUS A. M. Edwards

PHYMODIUS UNGULATUS (M. Edwards).

Chlorodius ungulatus M. EDWARDS, Hist. Nat. Crust. 1 (1834) 400, pl. 16, figs. 6–8; DANA, U. S. Explor. Exped. Crust. (1852) 205, pl. 11, fig. 8.

Chlorodius areolatus ADAMS and WHITE, Zoöl. Voy. Samarang, Crust. (1850) 41, pl. 11, fig. 3.

Phymodius ungulatus A. M. EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 218; HASWELL, Cat. Austral. Crust. (1882) 59.

Phymodius monticulosus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 139; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 163.

COMIRAN, Palawan Province, 0099. MINDANAO, Zamboanga Province (Challenger).

Alliance XANTHODIOIDA

Genus XANTHODES Dana

XANTHODES DEPRESSUS White.

Xanthodes depressus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 127.

MENIPPINÆ

Alliance MENIPPIOIDA

Genus MENIPPE de Haan

MENIPPE CONVEXA Rathbun.

Menippe convexa RATHBUN, Proc. U. S. N. M. 16 (1893) 239; RATHBUN, Brachyura and Macrura of Hawaiian Islands (1906) 861.

Locality not indicated, 0–1557.

OZIINÆ

Alliance OZIOIDA

Genus EPIXANTHUS Heller

EPIXANTHUS DENTATUS (White).

Panopeus dentatus WHITE, P. Z. S. (1847) 226.

Heteropanope dentatus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 35.

Epixanthus dentatus MIERS, Ann. Mag. Nat. Hist. (5) 5 (1880) 35; ORTMANN, Zoöl. Jahrb. Syst. 7 (1894) 478; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 185.

PALAWAN, Malapaya Sound, 0–1025.

EPIXANTHUS FRONTALIS (Milne Edwards).

Ozius frontalis MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 406.

Epixanthus frontalis HELLER, Novara, Crust. p. 20; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 477; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 185.

MINDORO, Mindoro Province, Puerto Galera, 0–1790.

Alliance RUPPELLIOIDA

Genus BAPTOZIUS Alcock

BAPTOZIUS VINOSUS (Milne Edwards).

Ruppellia vinosa MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 422.
Euruppellia vinosa DE MAN, in Weber's Zoöl. Ergeb. Niederl. Ost.-Ind. 2 (1892) 278, pl. 1, fig. 1.
Baptozius vinosus ALCOCK, Carc. Fauna, India, Journ. Asiat. Bengal 67 (1898–99) 189.

MINDORO, Mindoro Province, Puerto Galera, 0–719, 0–1778.

Quite common under stones at the edges of marshy swamps.

PILUMNINÆ

Alliance PILUMNOIDA

Genus PILUMNUS Leach

PILUMNUS ORBITOSPINIS Rathbun.

Pilumnus orbitospinis RATHBUN, Trans. Linn. Soc. London, Zool. 14: 229.

LUZON, Albay Province, Legaspi, 0–971. SAMAR, Samar Province, Catbalogan, 0–992.

PILUMNUS VESPERTILIO (Fabricius).

Cancer vespertilio FABRICIUS, Ent. Syst. 2 : 463, and Suppl. p. 338.
Pilumnus ursulus ADAMS and WHITE, Zoöl. Voy. Samarang, Crust. (1850) 45, pl. 9, fig. 6.
Pilumnus vespertilio A. M. EDWARDS, Nouv. Archiv. Mus. 9 (1873) 242; HENDERSON, Trans. Linn. Soc. Zool. (2) 5 (1893) 365; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 67 (1898–99) 192.

MINDORO, Mindoro Province, Puerto Galera, 0–194; Calapan, 0109. BANTAYAN, Cebu Province, 0–208. LUZON, Bataan Province, Mariveles, 0–284; Ilocos Sur Province.

One of the commonest littoral crabs on rocky shores.

PILUMNUS GEMMATUS Stimpson.

Pilumnus gemmatus STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1860) 214; RATHBUN, U. S. N. M. Bul. 152 (1930) 513, pl. 207, figs. 1–3.

SAMAR, Samar Province, Catbalogan, 0107.

PILUMNUS DE HAANI Miers.

Pilumnus de haani MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 155, pl. 14, fig. 1; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 198.

Dredged at 11° 37′ 0″ north latitude, 123° 31′ 0″ east longitude, from depth of 18 fathoms in mud bottom (Challenger).

PILUMNUS SPINOHIRSUTUS (Lockington).

Acanthus spino-hirsutus LOCKINGTON, Proc. Calif. Acad. Sci. 7 (1876) 33.

Pilumnus spinohirsutus STREETS and KINGSLEY, Bul. Essex Inst. 9 (1877) 107 (part); RATHBUN, U. S. N. M. Bul. 152 (1930) 503, pl. 203.

SAMAR, Samar Province, Catbalogan, 0–905.

PILUMNUS SCABRIUSCULUS Adams and White.

Pilumnus scabriusculus ADAMS and WHITE, Crust. Zoöl. Samarang (1848) 44, pl. 9, fig. 5; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886).

JOLO, 0–1758. MINDANAO, Zamboanga Province.

ERIPHIINÆ [21]

Alliance ERIPHIOIDA

Genus ERIPHIA Latreille

ERIPHIA SPINIFRONS (Herbst).

Eriphia spinifrons M. EDWARDS, Hist. Nat. Crust. 1 (1834) 426; Atlas Cuvier Regn. Anim. (1849) pl. 14, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 479.

NEGROS, Oriental Negros Province, Zamboanguita, 0103.

ERIPHIA SCABRICULA Dana.

Eriphia gonagra KRAUSS, Süd-Afrik. Crust. (1843) 36.

Eriphia scabricula DANA, U. S. Explor. Exped. Crust. (1852) 247, pl. 14, fig. 5; A. M. EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 256; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 480.

Sulu Sea (Dana).

ERIPHIA LÆVIMANA Latreille.

Eriphia lævimana M. EDWARDS, Hist. Nat. Crust. 1 (1834) 427; DANA, U. S. Explor. Exped. Crust. (1852) 249, pl. 14, fig. 7; HILGENDORF, Decken's Reise, Bd. 3 1 (1869) 75; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Syst. 7 (1894) 480.

Eriphia trapeziformis HESS, Decapod. Krebse Ost-Austral. (1865) 9, pl. 6, fig. 4.

Genus TRAPEZIA Latreille

(= *Grapsilus* MacLeay)

TRAPEZIA CYMODOCE (Herbst).

Cancer cymodoce HERBST, Krabben u. Krebse III, pl. 51, fig. 5.

Trapezia dentata A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 9 (1873) 261, pl. 9.

Trapezia cymodoce MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 166; DE MAN, Journ. Linn. Soc. 22 (1888) 69.

MINDORO, Mindoro Province, Puerto Galera 0–1763. MINDANAO, Zamboanga Province (Challenger) from a reef. These are coral crabs.

[21] In the Oziinæ and Eriphiinæ, the family Xanthidæ approaches the Telphusidæ (Potamonidæ); by the Pilumninæ and Xanthinæ it is linked with the section Carcinæ of the Portunidæ and, through these, with the Cancridæ.—ALCOCK.

TRAPEZIA CYMODOCE var. DENTATA Dana.

Trapezia dentata DANA, U. S. Explor. Exped. Crust. (1852) 258, pl. 15, figs. 6, 7.

Trapezia ferruginea DANA, ibid, 260, pl. 16, fig. 1.

Trapezia miniata JACQUINOT et LUCAS, Voy. Pole Süd-Zool. Crust. 3 (1853) 43, pl. 4, fig. 10.

Trapezia cymodoce var. *dentata* ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 483.

Sulu Sea (Dana).

TRAPEZIA AREOLATA Dana.

Trapezia areolata DANA, U. S. Explor. Exped. Crust. (1852) 259, pl. 15, figs. 8, 9.

Trapezia reticulata STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 37.

Trapezia areolata var. *inermis* A. M. EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 259, pl. 10, fig. 6.

MINDORO, Mindoro Province, Puerto Galera, 0–1764. Sulu Sea (Dana).

TRAPEZIA RUFOPUNCTATA (Herbst).

Cancer rufopunctata HERBST, Krabben 3 (1799) 54, pl. 47, fig. 6.

Trapezia rufopunctata MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 167; ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 67 (1898–99) 222.

MINDORO, Mindoro Province, Puerto Galera, 0–529, 0–1712, 0–1762. MINDANAO, Zamboanga Province (Challenger), 10 fathoms.

Genus QUADRELLA Dana

QUADRELLA CORONATA Dana.

Quadrella coronata DANA, U. S. Explor. Exped. Crust. (1852) 266, pl. 16, fig. 5; ORTMANN, Zoöl. Jahrb. Syst. 10 (1898) 210.

Quadrella nitida SMITH, Proc. Boston Soc. Nat. Hist. 12 (1889) 288; LOCKINGTON, Proc. Acad. Calif. Sci. 7 (1876) 105.

Sulu Sea (Dana).

POTAMONIDÆ [22]

(= Telphusidæ)

Genus POTAMON Savigni

(= *Telphusa* Latreille)

POTAMON (PARATELPHUSA) GRAPSOIDES (Milne Edwards).

Telphusa grapsoides WHITE, List Crust. Brit. Mus. (1847) 30; MILNE EDWARDS, Ann. Sci. Nat. Zoöl. (3) 20 (1853) 212; DE MAN, Journ. Linn. Soc. London 22 (1887) 96; BÜRGER, Zoöl. Jahrb. Syst. 5 (1895) 2.

[22] "The Telphusidæ are the highest Cyclometopes, and approach the Catometopa. They appear to me from consideration both of structure and habitat, to have branched off from the Oziinæ or Eriphiinæ stocks, but are now inhabitants of fresh water or damp jungle."—ALCOCK, Journ. Asiat. Soc. Bengal 65.

Telphusa hydrodromus GERSTAECKER, Arch. f. Naturg. 22 1 (1856) 150, part.

Potamon grapsoides DE MAN, Ann. Mus. Civ. Stor. Nat. Genova (2) 19 (1898) 436.

Potamon (Potamon) grapsoides RATHBUN, Nouv. Archiv. du Mus. IV 6 (1904) 300, pl. 13, fig. 9.

These crabs are abundant in Luzon, Laguna Province, Los Baños, Molawin Creek; San Juan River, Calamba, and in regions around Laguna Bay. The specimen in the collection of the Goettinger Museum came from Lake Mainit.

POTAMON (TELPHUSA) ANGUSTIFRONS M. Edwards.

Telphusa angustifrons A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris 5 (1869) 171; BÜRGER, Zool. Jahrb. Syst. 8 (1895) 3, pl. 1, fig. 1.

NEGROS, Oriental Negros Province, Luzuriaga, 0161.

POTAMON (TELPHUSA) SINUATIFRONS (M. Edwards).

Telphusa sinuatifrons M. EDWARDS, Ann. Sci. Nat. III Zool. 20 (1853) 211; A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 5 (1869) 177, pl. 10, fig. 2; MIERS, Ann. Mag. Nat. Hist. V 5 (1880) 305; Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 214, pl. 18, fig. 1; BÜRGER, Zool. Jahrb. Syst. 8 (1895) 2.

MINDANAO, Pasonanca (Challenger). Locality not indicated, 0167. The Goettinger Zoölogical Museum has three specimens collected from the Philippines.

POTAMON (TELPHUSA) LESCHENAULTI (M. Edwards).

Telphusa leschenaulti A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris 5 (1869) 165, pl. 8, fig. 3; BÜRGER, Zool. Jahrb. Syst. 8 (1895) 2.

BOHOL (Bürger).

POTAMON (TELPHUSA) PHILIPPINA Martens.

Telphusa philippina MARTENS, Monatsber. K. Preuss. Ak. Wiss. Berlin (1869) 609; BÜRGER, Zoöl. Jahrb. Syst. 8 (1895) 4, pl. 1, fig. 3.

LUZON, Agno River, Palanan; Bataan Province, Mariveles. CAMIGUIN.

POTAMON (TELPHUSA) MONTANA Bürger.

Telphusa montana BÜRGER, Zool. Jahrb. Syst. 8 (1895) 6, pl. 1, fig. 5.

Bürger's specimen came from Mount Data, Luzon, from an altitude of 7,000 ft.

POTAMON (PARATELPHUSA) TRIDENTATA (Milne Edwards).

Paratelphusa tridentata MILNE EDWARDS, Ann. Sci. Nat. (3) Zoöl. 20 (1853) 213; MILNE EDWARDS, Archiv. Mus. Paris 7 (1854–55) 171, pl. 13, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 487.

Locality not indicated, 0169.

POTAMON (TELPHUSA) LÆVIS Wood-Mason.

LUZON, Camarines Sur Province, Lake Buhi, 0166.

Genus PSEUDOTELPHUSA

PSEUDOTELPHUSA ANGULATA Rathbun.

Pseudotelphusa angulata RATHBUN, Proc. Bio. Soc. Wash. 28 (1915) 98; PEARSE, Proc. U. S. N. M. 49 (1915) 552, pl. 72, figs. 1–5.

MINDORO, Mindoro Province, Puerto Galera, 0–1863. From under bowlders at the head of Tabinay Creek.

Tribe CATOMETOPA

Family GONEPLACIDÆ Dana

CARCINOPLACINÆ

Genus CARCINOPLAX Milne Edwards

CARCINOPLAX BISPINOSA Rathbun.

Carcinoplax bispinosa RATHBUN, Proc. U. S. N. M. 48 (1914) 137.

North of MARINDUQUE. LUZON, Tayabas light (outer), 90 fathoms (Albatross).

CARCINOPLAX SPINOSISSIMA Rathbun.

Carcinoplax spinosissima RATHBUN, Proc. U. S. N. M. 48 (1914) 139.

Between CEBU and BOHOL. CEBU, Lauis Point, 165 fathoms (Albatross).

CARCINOPLAX CONFRAGOSA Rathbun.

Carcinoplax confragosa RATHBUN, Proc. U. S. N. M. 48 (1914) 140.

Between CEBU and BOHOL. BOHOL, Cruz Point, 127 fathoms (Albatross).

CARCINOPLAX PURPUREA Rathbun.

Carcinoplax purpurea RATHBUN, Proc. U. S. N. M. 48 (1914) 140.

Near MARINDUQUE. LUZON, Tayabas Light (outer), 90 fathoms (Albatross).

CARCINOPLAX ANGUSTA Rathbun.

Carcinoplax angusta RATHBUN, Proc. U. S. N. M. 48 (1914) 142.

Near MARINDUQUE. LUZON, Tayabas Light (outer), 90 fathoms (Albatross).

CARCINOPLAX VERDENSIS Rathbun.

Carcinoplax verdensis RATHBUN, Proc. U. S. N. M. 48 (1914) 143.

Verde Island Passage. SOMBRERO, 394 fathoms (Albatross).

CARCINOPLAX SPECULARIS Rathbun.

Carcinoplax specularis RATHBUN, Proc. U. S. N. M. 48 (1914) 143.

Off southern LUZON: SOMBRERO, 159 fathoms (Albatross).

Genus PSOPHETICUS Wood-Mason

PSOPHETICUS HUGHI Rathbun.

Psopheticus hughi RATHBUN, Proc. U. S. N. M. 48 (1914) 144.

Northern MINDANAO, Macabalan Point, 200 to 220 fathoms (Albatross).

GONEPLACINÆ

Genus GONEPLAX Leach

GONEPLAX RENOCULIS Rathbun.

Goneplax renoculis RATHBUN, Proc. U. S. N. M. **48** (1914) 145.

Off southern LUZON. MALAVATUAN, 80 to 102 fathoms (Albatross).

RHIZOPINÆ

Genus CERATOPLAX Stimpson

CERATOPLAX FULGIDA Rathbun.

Ceratoplax fulgida RATHBUN, Proc. U. S. N. M. **48** (1914) 146.

Near MARINDUQUE. LUZON, Tayabas Light (outer), 83 fathoms (Albatross).

CERATOPLAX TRUNCATIFRONS Rathbun.

Ceratoplax truncatifrons RATHBUN, Proc. U. S. N. M. **48** (1914) 147.

Off Western SAMAR. BADIAN, 32 fathoms (Albatross).

Genus TYPHLOCARCINUS Stimpson

TYPHLOCARCINUS CRATERIFER Rathbun.

Typhlocarcinus craterifer RATHBUN, Proc. U. S. N. M. **48** (1914) 147.

East of MASBATE. DESTACADO, 80 fathoms (Albatross).

Genus HEPHTHOPELTA Alcock

HEPHTHOPELTA APTA Rathbun.

Hephthopelta apta RATHBUN, Proc. U. S. N. M. **48** (1914) 148.

Between CEBU and BOHOL, Lauis Point Light, 175 fathoms (Albatross).

Genus CHASMOCARCINUS Rathbun

CHASMOCARCINUS CAVIMANUS Rathbun.

Chasmocarcinus cavimanus RATHBUN, Proc. U. S. N. M. **48** (1914) 149.

Tañon Strait, east coast of NEGROS. PESCADOR, 300 fathoms (Albatross).

TYPHLOCARCINOPSINÆ

Genus TYPHLOCARCINOPS Rathbun

TYPHLOCARCINOPS DECRESCENS Rathbun.

Typhlocarcinops decrescens RATHBUN, Proc. U. S. N. M. **48** (1914) 151.

Sulu Archipelago, Tawitawi Group. TINAKTA, 16 fathoms (Albatross).

TYPHLOCARCINOPS MARGINATA Rathbun.

Typhlocarcinops marginata RATHBUN, Proc. U. S. N. M. **48** (1914) 152.

Off southern PALAWAN. THIRTIETH OF JUNE, 27 fathoms (Albatross).

TYPHLOCARCINOPS ANGUSTIFRONS Rathbun.

Typhlocarcinops angustifrons RATHBUN, Proc. U. S. N. M. **48** (1914) 153.

Between MARINDUQUE and LUZON. SAN ANDREAS, 50 fathoms (Albatross).

TYPHLOCARCINOPS OCULARIA Rathbun.

Typhlocarcinops ocularia RATHBUN, Proc. U. S. N. M. **48** (1914) 153.

Between SAMAR and MASBATE. DESTACADO, Tubig Point, 135 fathoms (Albatross).

GRAPSIDÆ

GRAPSINÆ

Genus GRAPSUS Lamarck, Kingsley

GRAPSUS GRAPSUS (Linnæus).

Cancer grapsus LINNÆUS, Syst. Nat. ed. 10 **1** (1758) 630.

Grapsus (Goniopsis) pictus DE HAAN, Fauna Japon. Crust. (1835) 33.

Grapsus ornatus MILNE EDWARDS, Ann. Sci. Nat. III Zool. **20** (1853) 167.

Grapsus grapsus ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 392.

MINDORO, Mindoro Province, Puerto Galera, 0–1742. LUZON, Cavite Province, San Roque, 0–1743. PALAWAN, Taytay, 0–1342.

GRAPSUS STRIGOSUS (Herbst).

Cancer strigosus HERBST, Krabben, III **1**: 55, pl. 47, fig. 7.

Goniopsis strigosus DE HAAN, Fauna Japon. Crust. (1835) 33.

Grapsus strigosus MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. **17** (1886) 256; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 393.

LUZON, Ilocos Norte Province, Banua, 0048. MINDORO, Mindoro Province, Calapan, 0049.

Genus METOPOGRAPSUS Milne Edwards

METOPOGRAPSUS MESSOR (Forskål).

Cancer messor FORSKÅL, Descript. Anim. in itin. oriend. p. 88.

Grapsus messor M. EDWARDS, Hist. Nat. Crust. **2** (1837) 88.

Metopograpsus messor ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 397.

LUZON, Rizal Province, Pasay, 0–43.

METOPOGRAPSUS LATIFRONS (White).

Grapsus latifrons WHITE, Jukes' Voy. "Fly" **2** (1847) 337, pl. 2, fig. 2.

Metopograpsus latifrons H. M. EDWARDS, Ann. Sci. Nat. III **20** (1853) 283; ORTMANN, Zoöl. Jahrb. Syst. **7** (1894) 703; TESCH, Decapod. Siboga Exped. **82** (1918) 81.

Metopograpsus pictus DE MAN, Notes Leyden Mus. **1** (1879) 68.

DINAGAT, Surigao Province, 0050.

METOPOGRAPSUS MACULATUS H. M. Edwards.

Metopograpsus maculatus H. M. EDWARDS, Ann. Sci. Nat. III 20 (1853) 165; DE MAN, Journ. Linn. Soc. London 22 (1888) 145, pl. 10, figs. 1, 3.

LUZON, Bataan Province, Orani, 0051.

Genus GEOGRAPSUS Stimpson

GEOGRAPSUS LIVIDUS (Milne Edwards).

Grapsus lividus MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 85.
Geograpsus occidentalis STIMPSON, Ann. Lyc. Nat. Hist. New York 7 (1860) 230.
Geograpsus lividus RATHBUN, U. S. N. M. Bul. 97 (1916) 232, pl. 55.

Locality not indicated, 0047.

Subfamily SESARMINÆ Dana

Genus SESARMA Say

SESARMA BIDENS (de Haan).

Grapsus (Pachysoma) bidens DE HAAN, Fauna Japon. Crust. (1835) 60, pl. 16, fig. 4.
Sesarma bidens A. M. EDWARDS, Nouv. Archiv. Mus. 5 (1869); BÜRGER, Zoöl. Jahrb. Syst. 7 (1893) 628; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 415.

LUZON, Manila, from an estero, 0–203; Camarines Sur Province, Calabanga, 0061. PANAY, Capiz Province, 0060.

SESARMA TÆNIOLATA White.

Sesarma tæniolatum WHITE, List Crust. Brit. Mus. (1847) 38; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 419.
Sesarma mederi MILNE EDWARDS, Ann. Sci. Nat. Zool. (2) 20 (1853) 185.
Sesarma tæniolata BÜRGER, Zoöl. Jahrb. Syst. 7 (1893) 615.

MINDORO, Mindoro Province, Puerto Galera, 0–404. MACTAN, Cebu Province, 0072. SULU, Sulu Province, Paticul, 0076. PANAY, Iloilo Province, Dumangas, 0077. LUZON, Manila (Bürger).

SESARMA (PARASESARMA) MOLUCENSE JAMELENSE Rathbun.

Sesarma (Parasesarma) molucense jamelense RATHBUN, Proc. U. S. N. M. (1907) 81.

PALAWAN, Taytay, 0–1200, from brackish water.

SESARMA (SESARMA) BIDENTATUM Benedict.

Sesarma bidentata BENEDICT, Johns Hopkins Univ. Cir. 11 (1892) 77.
Sesarma (Sesarma) bidentatum RATHBUN, U. S. N. M. Bul. 97 (1916) 295, pl. 80.

SEYCHELES, Mindoro Province, 0–1495.

SESARMA DUSSUMIERI M. Edwards.

Sesarma dussumieri M. EDWARDS, Ann. Sci. Nat. 20 (1853) 185; DE MAN, Journ. Linn. Soc. London 22 (1888) 177, pl. 12, figs. 8–12.

PANAY, Iloilo Province, La Paz, 0062.

SESARMA AUBRYI A. M. Edwards.

Sesarma aubryi A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 5 (1869); MIERS, Proc. Zoöl. Soc. (1877) 137; DE MAN, Journ. Linn. Soc. London 22 (1888) 168.

MINDORO, Mindoro Province, Calapan, 0059.

SESARMA LIVIDA A. M. Edwards.

Sesarma livida DE MAN, Journ. Linn. Soc. London 22 (1888) 179.
Sesarma (*Chiromantes*) *livida* TESCH, Zoöl. Med. Mus. Leiden 3 (1917) 169.

MACTAN, Cebu Province, 0063.

SESARMA (SESARMA) PALAWENSE Rathbun.

Sesarma (*Sesarma*) *palawensis* TESCH, Zoöl. Med. Mus. 3 (1917) 183, pl. 16, fig. 2.

MACTAN, Cebu Province, 0067. PANAY, Iloilo Province, Barotac Nuevo, 0068.

SESARMA (SESARMA) MINDANAOENSE Rathbun.

Sesarma (*Sesarma*) *mindanaoense* RATHBUN, Proc. U. S. N. M. 47 (1915) 75.

LEYTE, Leyte Province, Cabalian, 0064. NEGROS, Negros Oriental Province, Dumaguete River, 0065. JOLO, Sulu Province, Paticul, 0066.

SESARMA (SESARMA) VICENTENSE Rathbun.

Sesarma (*Sesarma*) *vicentense* RATHBUN, Proc. U. S. N. M. 47 (1907–10).

LUZON, Port San Vicente. PALANI, off northern LUZON.

SESARMA (SESARMA) EDWARDSI PHILIPPINENSI Rathbun.

Sesarma (*Sesarma*) *edwardsi philippinensi* RATHBUN, Proc. U. S. N. M. 47 (1907–10).

BUSUANGA, Palawan Province, Pangauran River, Port Caltom.

SESARMA (SESARMA) TECTUM Rathbun.

Sasarma (*Sesarma*) *tectum* RATHBUN, Proc. U. S. N. M. 47 (1907–10).

PALANI, off Northern LUZON, Port San Vicente.

SESARMA (PARASESARMA) DUMACENSE Rathbun.

Sesarma (*Parasesarma*) *dumacense* RATHBUN, Proc. U. S. N. M. 47 (1907–10) 80.

LUZON, Dumaca River.

SESARMA (PARASESARMA) PANGAURANENSE Rathbun.

Sesarma (*Parasesarma*) *pangauranense* RATHBUN, Proc. U. S. N. M. 47 (1907–10).

BUSUANGA, Pangauran River, Port Caltom.

SESARMA TRAPEZOIDEA Guerin.

Sesarma trapezoidea DE MAN, Zoöl. Jahrb. Syst. 2 (1887) 654; Zoöl. Jahrb. Syst. 4 (1889) 426, pl. 9, fig. 7; pl. 10, fig. 8; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 719.

Philippines (Ortmann).

SESARMA MEINERTI de Man.

Sesarma tetragona MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 73; A. M. EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 304.

Sesarma meinerti DE MAN, Zoöl. Jahrb. Syst. 2 (1887) 648; BÜRGER, Zoöl. Jahrb. Syst. 7 (1893) 617; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 721.

BOHOL (Bürger).

SESARMA EDWARDSI de Man.

Sesarma edwardsi DE MAN, Zool. Jahrb. 2 (1887) 649; Journ. Linn. Soc. London 22 (1888) 185, pl. 13, figs. 1–4; BÜRGER, Zool. Jahrb. Syst. 7 (1893) 617, var.; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 721.

Philippines (Bürger).

SESARMA SMITHI Milne Edwards.

Sesarma smithi MILNE EDWARDS, Archiv. Mus. Paris 7 (1885) 149, pl. 9, fig. 2; A. MILNE EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 305; DE MAN, Zoöl. Jahrb. 2 (1887) 852; BÜRGER, Zoöl. Jahrb. 7 (1893) 618, pl. 21, fig. 2; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 722.

Manila (Bürger).

SESARMA IMPRESSA Milne Edwards.

Sesarma impressa MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 74; MILNE EDWARDS, Ann. Nat. Sci. (3) Zool. 20 (1853) 186; DE MAN, Zoöl. Jahrb. 2 (1887) 653, 671; BÜRGER, Zoöl. Jahrb. 7 (1893) 620, pl. 21, figs. 4, 5; ORTMANN, Decapod. Krebse Strassburger Zoöl. Jahrb. Syst. 7 (1894) 723.

Sesarma similis HESS, Decapod. Krebse Ost-Austral. (1865) 24; HASWELL, Cat. Austral. Crust. (1882) 108.

LUZON, Bataan Province, Mariveles, 2,000 ft. above sea level (Bürger). The place is probably Mariveles.

SESARMA UNGULATA Milne Edwards.

Sesarma ungulata DE MAN, Journ. Linn. Soc. 22 (1888) 168.

Philippines.

SESARMA OBLONGA de Man.

Sesarma oblonga DE MAN, Journ. Linn. Soc. 22 (1888) 189.

Philippines.

Genus METASESARMA Milne Edwards

METASESARMA ROUSSEAUXI Milne Edwards.

Sesarma aubryi DE MAN, Archiv f. Naturg. Jg. 53 1 (1887) 372; DE MAN, Zool. Jahrb. 4 (1887) 661.

Metasesarma rousseauxi DE MAN, Zool. Jahrb. 4 (1889) 439; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 717.

LUZON (Ortmann).

Genus HELICE de Haan

HELICE LATREILLEI Milne Edwards.

Cyclograpsus latreillei MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 80.

Helice latreillei MILNE EDWARDS, Ann. Sci. Nat. 18 (1852) 190; MIERS, Rept. Voy. Challenger, Brachyura 17 (1886) 268, pl. 21, fig. 2.

MINDANAO, Zamboanga Province, from a reef, 10 fathoms (Challenger).

Subfamily VARUNINÆ Alcock

Genus VARUNA Milne Edwards

VARUNA ALTIMANA Rathbun.

Varuna altimana RATHBUN, Proc. U. S. N. M. 47 (1907–10) 70.

Ptychognathus altimanus TESCH, Decapod. Brachyura, Siboga Exped. 82 (1918) 88, pl. 4, fig. 5.

MINDORO, Mindoro Province, Puerto Galera, 0–404. NEGROS, Negros Oriental Province, Dumaguete, 0074. SULU, Jolo Province, Paticul, 0076. PANAY, Iloilo Province, Dumangas, 0077. LUZON, Ilocos Sur Province; Ilocos Norte Province.

VARUNA LITTERATA (Fabricius).

Cancer litteratus FABRICIUS, Ent. Syst. Suppl. p. 342.

Varuna litterata MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 95, pl. 14, fig. 8; DANA, U. S. Explor. Exped. Crust. 13 (1852) 336, pl. 20, fig. 8; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 264; ALCOCK, Carc. Fauna. India, Journ. Asiat. Soc. Bengal 69 (1900) 401.

LUZON, Manila, 0–1369. MINDANAO, Zamboanga Province, Pasonanca.

Genus UTICA White

UTICA GRACILIPES White.

Utica gracilipes WHITE, Zoöl. Voy. Samarang, Crust. (1843–46) 53, pl. 12, fig. 6; MILNE EDWARDS, Ann. Sci. Nat. III Zoöl. 20 (1853) 177.

MINDORO, Mindoro Province, Puerto Galera, 0–1780. NEGROS, Negros Occidental Province.

Genus PTYCHOGNATHUS Stimpson

PTYCHOGNATHUS GUIJULUGANI Rathbun.

Ptychognathus guijulugani RATHBUN, Proc. U. S. N. M. 47 (1907–10) 71; TESCH, Decapoda, Brachyura, Siboga Exped. 82 (1918) 93, pl. 4, fig. 6.

LUZON, Bataan Province, Mariveles, 0–1434. MINDORO, Mindoro Province, Puerto Galera, N–106. LEYTE, Leyte Province, Bombon, 0057.

PTYCHOGNATHUS JOHANNÆ Rathbun.

Ptychognathus johannæ RATHBUN, Proc. U. S. N. M. 46: 354, pl. 30.

LUZON, Bataan Province, Mariveles, 0–47. MINDORO, Mindoro Province, Puerto Galera, 0–1740.

PTYCHOGNATHUS BARBATUS (A. M. Edwards).

Gnathograpsus barbatus A. M. EDWARDS, Nouv. Archiv. Mus. **9** (1873) 316, pl. 17, fig. 4.

Ptychognathus barbatus ORTMANN, Zool. Jahrb. Syst. **7** (1894) 712; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 406.

LUZON, Batangas Province, Bombon Lake, 0054.

Subfamily PLAGUSINÆ Dana

Genus PLAGUSIA Latreille

PLAGUSA DEPRESSA (Fabricius).

Cancer depressus FABRICIUS, Syst. Entom. (1775) 406.

Grapsus depressus BOSCH, Hist. Nat. Crust. **1** (1801–02) 203.

Plagusia depressa SAY, Journ. Acad. Nat. Sci. Philad. **1** (1815) 100; RATHBUN, U. S. N. M. Bul. **97** (1918) 532, pl. 101.

LUZON, Bataan Province, Mariveles, 0–952, 0–975, 0–955; Albay Province, Legaspi; Cavite Province, Looc.

PLAGUSIA DEPRESSA var. SQUAMOSA (Herbst).

Cancer squamosa HERBST, Krabben **1** (1790) 260, pl. 20, fig. 113.

Plagusia squamosa A. M. EDWARDS, Nouv. Archiv. Mus. **9** (1873) 298.

Plagusia tuberculata MIERS, Ann. Mag. Nat. Hist. (5) **1** (1878) 148; DE MAN, Notes Leyden Mus. **5** (1888) 168.

Plagusia depressa MILNE EDWARDS, Ann. Sci. Nat. Zoöl. (3) **20** (1853) 179.

Plagusia orientalis STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 103.

Plagusia depressa var. *squamosa* ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 437.

LUZON, Bataan Province, Mariveles, 0–154.

PLAGUSIA IMMACULATA Lamarck.

Plagusia immaculata LAMARCK, Hist. Nat. Anim. sans Vert. **5** (1818) 247; HASWELL, Cat. Austral. Crust. (1882) 110; MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. **17** (1886) 273, pl. 22, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. **7** (1894) 730.

Philippines (Miers).

Genus PERCNON Gistel

PERCNON GIBBESI (Milne Edwards).

Acanthopus gibbesi MILNE EDWARDS, Ann. Sci. Nat. III Zool. **20** (1853) 180.

Leiolephus planissimus MIERS, Ann. Mag. Nat. Hist. V **1** (1878) 153; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 439.

Percnon planissimum RATHBUN, Proc. U. S. N. M. **22** (1900) 281.

Perenon gibbesi RATHBUN, U. S. N. M. Bul. **97** (1918) 337, pl. 105.

MINDORO, Mindoro Province, Puerto Galera, 0–1407. LUZON, Bataan Province, Mariveles; Cavite Province, Looc.

Family GEOCARCINIDÆ Dana

Genus CARDISOMA Latreille

CARDISOMA CARNIFEX (Herbst).

Cardisoma carnifex HERBST, Krabben etc. 2 (1794) 163, pl. 12, figs. 1, 2.

Cardisoma guanhumi var. *carnifex* ORTMANN, Zool. Jahrb. Syst. 7 (1893–94) 735.

Cardisoma carnifex ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 445.

NEGROS, Occidental Negros Province, 0–122. PALAWAN, Taytay, 0–1326; Balabac, 0084. DINAGAT, Surigao Province, 0083.

CARDISOMA HIRTIPES Dana.

Cardisoma hirtipes DANA, U. S. Explor. Exped. Crust. (1852) 376, pl. 24, fig. 2; MILNE EDWARDS, Ann. Soc. Nat. (3) Zool. 20 (1853) 205; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 447.

Discoplax longipes A. M. EDWARDS, Ann. Soc. Entom. France (4) 7 (1867) 284; A. M. EDWARDS, Nouv. Archiv. Mus. Paris 4 (1873) 294, pl. 15.

Locality not indicated.

Genus GECARCOIDEA Milne Edwards

GECARCOIDEA LALANDII Milne Edwards.

Gecarcoidea lalandii MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 25; RATHBUN, U. S. N. M. Bul. 97 (1918) 364, pl. 100, figs. 7, 8; TESCH, Decapoda Siboga Exped. 82 (1918) 138.

Pelocarcinus lalandii MILNE EDWARDS, Ann. Sci. Nat. III 20 (1853) 203.

Hylæcarcinus hunei WOOD-MASON, Journ. Asiat. Soc. Bengal 42 (1873) 260, pls. 15, 16.

Limnocarcinus intermedius DE MAN, Notes Leyden Mus. 1 (1879) 65.

MINDORO, Mindoro Province, Puerto Galera, 0–22.

Genus GECARCINUS Leach

GECARCINUS RURICULA (Linnæus).

Cancer terrestris cuniculus sub terra agens SLOANE, Voy. Jamaica 1 (1707), pl. 2; 2 (1725) 269.

Cancer ruricula LINNÆUS, Syst. Nat. ed. 10 1 (1758) 626; HERBST, Naturg. Krabben u. Krebse 1 (1783) 119, pl. 3, fig. 36.

Gecarcinus ruricula LEACH, Trans. Linn. Soc. London 11 (1815) 322; RATHBUN, U. S. N. M. Bul. 97 (1918) 352, pls. 117, 118.

Ocypoda rubra FREMINVILLE, Ann. Sci. Nat. II Zool. 3 (1835) 222.

MINDORO, Mindoro Province, Calapan, 0058.

Family OCYPODIDÆ Ortmann

Subfamily OCYPODINÆ Dana

Genus OCYPODE Fabricius

OCYPODE GAUDICHAUDII Milne Edwards and Lucas.

Ocypode gaudichaudii MILNE EDWARDS and LUCAS, d' Orbigny's Voy. dans l' Amer. Merrid. Crust. 6 (1843) 26; RATHBUN, U. S. N. M. Bul. 97 (1918) 373, pl. 129, fig. 1; pl. 130, fig. 1; SCHMIDT, Marine Decapod. Crust. Univ. Calif. Publ. 23 (1921) 278.

COMIRAN, Palawan Province, 0–1783. MINDORO, Mindoro Province, Puerto Galera, Mamucan. CAGAYANCILLO, Palawan Province.

OCYPODE ALBICANS Bosc.

Cancer arenarius CATESBY, Nat. Hist. Carolina 2 (1743) 35, pl. 35.
Cancer vocans LINNÆUS, Syst. Nat. ed. 10 1 (1758) 626 (part).
Cancer quadratus FABRICIUS, Mant. Ins. 1 (1787) 315.
Ocypode quadrata FABRICIUS, Ent. Syst. Suppl. (1798) 348.
Ocypode albicans BOSC, Hist. Nat. Crust. 1 and 10 (1801–2) 196; LATREILLE, Hist. Nat. Crust. 6 and 11 (1802) 48; RATHBUN, U. S. N. M. Bul. 97 (1918) 367, pls. 127, 128.

COMIRAN, Palawan Province, 0–1745. CAGAYANCILLO, Palawan Province, Mamucan.

These crabs are known as sand crabs or ghost crabs.

OCYPODE CERATOPHTHALMA (Pallas).

Cancer cursor HERBST, Krabben 1 (1790) 74, pl. 1, figs. 8, 9.
Ocypode ceratophthalma FABRICIUS, Ent. Syst. Suppl. p. 347; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 345.

LUZON, Bataan Province, Mariveles, 0–48; Bulacan Province, 0041: Albay Province, Tabaco, 0046. POLILLO, Tayabas Province, 0042. COMIRAN, Palawan Province, 0043. BANTAYAN, Cebu Province, 0044.

OCYPODE CORDIMANA Desmarest.

Ocypode cordimana MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 45; Ann. Sci. Nat. (3) Zoöl. 18 (1852) 143; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1893–94) 764, pl. 23, fig. 16.
Ocypode laevis DANA, U. S. Explor. Exped. Crust. (1852) 325, pl. 20, fig. 2.

Manila (Heller).

Genus UCA Leach

(= *Gelasimus* Latreille)

UCA ANNULIPES (Latreille).

Gelasimus carionis M. EDWARDS, (nec. Desm.) Hist. Nat. Crust. 2 (1837) 53.
Cancer vocans minor HERBST, Krabben 1 (1790) 81, pl. 1, fig. 10.
Gelasimus annulipes MIERS, Rept. Voy. Challenger, Brachyura, Zoöl. 17 (1886) 244; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 353.

MINDORO, Mindoro Province, Calapan, 0006. MACTAN, Cebu Province. MINDANAO, Zamboanga (Challenger), 10 fathoms.

UCA TETRAGONA (Herbst).

Cancer tetragonon HERBST, Krabben 1 (1790) 257, pl. 20, fig. 110.
Gelasimus tetragonum ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 357.

NEGROS, Oriental Negros Province, Tamiso, 0033.

UCA TRIANGULARIS (A. M. Edwards).

Gelasimus perplexus HELLER, (nec. Edw.) Novara Crust. p. 38, pl. 5, fig. 4.
Uca triangularis NOBILI, Ann. Mus. Genov. (2) **20** (1899) 274.
Gelasimus triangularis ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 356.

PANAY, Capiz Province, Capiz, 0034. MACTAN, Cebu Province, 0035.

UCA DUSSUMIERI (M. Edwards).

Gelasimus longidigitum KINGSLEY, Proc. Acad. Nat. Sci. Philad. (1880) 144, pl. 9, figs. 10, 13.
Uca dussumieri ORTMANN, Zoöl. Jahrb. Syst. **10** (1897–98) 348.
Gelasimus dussumieri ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 361.

JOLO, Sulu Province, Sitankay, 0016. MACTAN, Cebu Province, 0017. NEGROS, Oriental Negros Province, Tamiso, 0018. BANTAYAN, Cebu Province, 0019.

UCA ACUTA (Stimpson).

Uca acuta DOFLEIN, S. B. Akad. Münch. **29** (1899) 193.
Gelasimus acutus ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 360.

PANAY, Iloilo Province, La Paz, 0001; Negros Oriental Province, Tinarian, 0002.

UCA ARCUATA (de Haan).

Gelasimus arcuatus MIERS, Ann. Mag. Nat. Hist. (5) **5** (1880) 309; HASWELL, Cat. Austral. Crust. (1882) 92; DE MAN, Notes Leyden Mus. **13** (1891) 28, pl. 3, fig. 7.

LUZON, Manila Bay, 0010. PANAY, Capiz Province, Capiz, 0011.

UCA COARCTATA (M. Edwards).

Gelasimus coarctatus DE MAN, Notes Leyden Mus. **13** (1891) 31, pl. 3, fig. 8; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. **7** (1893–94) 756.

LUZON, Manila Bay, 0012; Rizal Province, Malabon, 0013. PANAY, Capiz Province, 0014. BANTAYAN, Cebu Province, 0015. MINDANAO (Ortmann).

UCA SIGNATA (Hess).

Gelasimus signatus HASWELL, Cat. Austral. Crust. (1882) 93; DE MAN, Zool. Jahrb. 2 (1887) 697; Notes Leyden Mus. **13** (1891) 35,

pl. 4, fig. 11; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1893–94) 756.

PANAY, Capiz Province, Capiz, 0032.

UCA FORCIPATA (de Man).

Gelasimus forcipatus DE MAN, Notes Leyden Mus. 13 (1891) 32, pl. 3, fig. 9; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1893–94) 736.

LUZON, Manila Bay, 0027. NEGROS, Oriental Negros Province, Tamiso, 0029.

UCA VOCATOR (Herbst).

Gelasimus vocator KINGSLEY, Proc. Acad. Nat. Sci. Philad. (1880) 147, pl. 10, fig. 20; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1893–94) 757.

LUZON, Manila Bay, 0036. PALAWAN, Guinto, 0037. MACTAN, Cebu Province, 0038.

UCA MARIONIS (Desmarest).

Gelasimus cultrimanus WHITE, P. Z. S. (1847) 141, pl. 9, fig. 8.

Gelasimus marionis ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 359.

LUZON, Maytubig, 0030; Rizal Province, Pasay.

UCA MARIONIS var. NITIDA (Alcock).

Gelasimus nitidus DANA, U. S. Explor. Exped. Crust. 1 (1852) 316, pl. 19, figs. 6*a–d*.

Gelasimus vocans M. EDWARDS, Ann. Sci. Nat. III Zool. 18 (1802) 145.

Gelasimus marionis var. *nitida* ALCOCK, Carc. Fauna, India, Journ. Asiat. Soc. Bengal 69 (1900) 360.

LUZON, Manila, Estero, 0–10; Rizal Province, Malabon, 0–96.

UCA URVILLEI M. Edwards.

Gelasimus urvillei MILNE EDWARDS, Ann. Sci. Nat. III Zool. 13 (1852) 148, pl. 3, fig. 10; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal 69 (1900) 362.

LUZON, Manila, Georgia Street, Estero, 0–231.

UCA RATHBUNÆ Pearse.

Uca rathbunæ PEARSE, Philip. Journ. Sci. § D 7 (1912) 91, fig. 1; TESCH, Decapoda Siboga Exped. 82 (1918) 37.

LUZON, Manila, Estero, 0–15. MINDORO, Mindoro Province, Puerto Galera, 0–1839.

UCA ZAMBOANGANA Rathbun.

Uca zamboangana RATHBUN, Proc. U. S. N. M. 44 (1913) 615, pl. 74; TESCH, Decapoda Siboga Exped. 82 (1918) 37.

MINDANAO, Zamboanga Province (Rathbun).

UCA MEARNSI Rathbun.

Uca mearnsi RATHBUN, Proc. U. S. N. M. 44 (1913) 616, pl. 75, figs. 1, 2; TESCH, Decapoda, Siboga Exped. 82 (1916) 37.

MINDANAO, Davao Province (Rathbun).

UCA RUBRIPES Jacquinot and Lucas.

Gelasimus rubripes MILNE EDWARDS, Ann. Sci. Nat. III Zool. 18 (1852) 148, pl. 4, fig. 12; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 243.

MINDANAO, Zamboanga (Challenger), 10 fathoms.

UCA LATREILLEI Milne Edwards.

Gelasimus latreillei KINGSLEY, Proc. Acad. Nat. Sci. Philad. (1880) 152, pl. 10, fig. 31; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1893–94) 757.

Philippines (Kingsley).

UCA CULTRIMANA (White).

Gelasimus cultrimanus KINGSLEY, Proc. Acad. Nat. Sci. Philad. (1880) 140, pl. 9, fig. 7; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1893–94) 753.

Gelasimus vocans MIERS, Ann. Mag. Nat. Hist. (5) 5 (1880) 308; DE MAN, Notes Leyden Mus. 2 (1880) 67; HASWELL, Cat. Austral. Crust. (1882) 92.

LUZON (Ortmann).

Subfamily MACROPHTHALMINÆ Dana

Genus MACROPHTHALMUS Latreille

MACROPHTHALMUS DEFINITUS White.

Macrophthalmus definitus ORTMANN, Zool. Jahrb. Syst. 10 (1897) 342; RATHBUN, Bul. Mus. Comp. Zool. Harvard 72 No. 16, p. 307.

LUZON, Manila, Estero, 0–545. MINDORO, Mindoro Province, Puerto Galera.

MACROPHTHALMUS CRINITUS Rathbun.

Macrophthalmus sp. DE MAN, Abh. Senckenb. naturf. Ges. 25 (1902) 495.

Macrophthalmus pacificus RATHBUN, Bul. Mus. Comp. Zool. 52 (1910) 307, pl. 1, fig. 3 [not *M. pacificus* DANA (1861); DE MAN (1890)].

Macrophthalmus crinitus RATHBUN, Proc. U. S. N. M. 44 (1913) 618.

LUZON, 0–1754, locality not indicated.

MACROPHTHALMUS SANDAKANI Rathbun.

Macrophthalmus sandakani RATHBUN, Proc. U. S. N. M. 47 (1914) 82.

These crabs inhabit muddy beaches, and are quite abundant at mouths of streams. The writer has seen them collected for food at the mouth of Mambaling River in Cebu.

MACROPHTHALMUS JAPONICUS de Haan.

Macrophthalmus japonicus DE HAAN, Fauna Japon. Crust. (1850) 54, pl. 15, fig. 2; pl. 7, fig. 1; ADAMS and WHITE, Voy. Samarang (1850) 51; MILNE EDWARDS, Ann. Sci. Nat. III Zool. 18 (1852) 158.

LUZON, Manila Bay, 0078. BANTAYAN, Cebu Province, 0080. Locality not indicated, 0–1749.

MACROPHTHALMUS LATREILLEI (Desmarest).

Macrophthalmus latreillei MILNE EDWARDS, Hist. Nat. Crust. 2 (1837) 66; A. M. EDWARDS, Nouv. Archiv. Mus. Paris 9 (1873) 278; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1893–94) 747.

Macrophthalmus serratus ADAMS and WHITE, Zool. Voy. Samarang (1850) 51; MILNE EDWARDS, Ann. Sci. Nat. (3) Zool. 18 (1852) 159; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 250, pl. 20, fig. 1.

Philippines (Miers); LUZON (Ortmann).

SCOPIMERINÆ

Genus TYMPANOMERUS Rathbun

(=*Dioxippe* de Man)

TYMPANOMERUS PHILIPPINENSIS Rathbun.

Tympanomerus philippinensis RATHBUN, Proc. U. S. N. M. 47 (1914) 84; TESCH, Decapoda, Siboga Exped. 82 (1916) 49.

NEGROS, Negros Province, Guijulngan (Rathbun).

PINNOTHERIDÆ

PINNOTHERINÆ

Genus PINNOTHERES Latreille

PINNOTHERES AFFINIS Bürger.

Pinnotheres affinis BÜRGER, Zool. Jahrb. Syst. 8 (1895) 365, pl. 9, fig. 2; pl. 10, figs. 2, 3.

BOHOL, 4 females and 7 males.

PINNOTHERES GLABERRIMUS Bürger.

Pinnotheres glaberrimus BÜRGER, Beitrag z. Kenntnis d. Pinnotherien Zool. Jahrb. Syst. 8 (1895) 366, pl. 9, fig. 3; pl. 10, fig. 3.

MINDANAO, Zamboanga Province, taken from the shell of *Arca* collected from the brackish water.

PINNOTHERES CARDII Bürger.

Pinnotheres cardii BÜRGER, Zool. Jahrb. Syst. 8 (1895) 367, pl. 9, fig. 4; pl. 10, fig. 4.

BURIAS, one ovigerous female taken from the shell of *Cardium unedo*.

PINNOTHERES COARCTATUS Bürger.

Pinnotheres coarctatus BÜRGER, Zool. Jahrb. Syst. 8 (1895) 369, pl. 9, fig. 7; pl. 10, fig. 7.

Zamboanga Province, from the shell of Cahebe collected from brackish water.

PINNOTHERES MODIOLICOLA Bürger.

Pinnotheres modiolicola BÜRGER, Zool. Jahrb. Syst. 8 (1895) 370.

Philippines, one female from the shell of *Modiola philippinarum*.

PINNOTHERES PALAENSIS Bürger.

Pinnotheres palaensis BÜRGER, Beitrag z. Kenntnis d. Pinnotherien, Zool. Jahrb. Syst. **8** (1895) 372, pl. 9, fig. 12; pl. 10, fig. 12.

BURIAS, 2 males and 2 females, taken from the shell of *Byssoarca* sp.

PINNOTHERES LATISSIMUS Bürger.

Pinnotheres latissimus BÜRGER, Zool. Jahrb. Syst. **8** (1895) 373, pl. 9, fig. 13; pl. 10, fig. 13.

Manila.

PINNOTHERES LATUS Bürger.

Pinnotheres latus BÜRGER, Zool. Jahrb. Syst. **8** (1895) 374, pl. 9, fig. 16; pl. 10, fig. 15.

BURIAS, 4 females, taken from the shell of *Pinna* sp.

PINNOTHERES PARVULUS Stimpson.

Pinnotheres parvulus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 108; BÜRGER, Zool. Jahrb. Syst. **8** (1895) 376, pl. 9, fig. 18; pl. 10, fig. 17.

BURIAS, 2 females, taken from the shell of *Mytilus* (Bürger).

PINNOTHERES EXIGUUS Bürger.

Pinnotheres exiguus BÜRGER, Zool. Jahrb. Syst. **8** (1895) 377, pl. 9, fig. 19; pl. 10, fig. 30.

SAMAR, 4 females, 3 of which were ovigerous.

PINNOTHERES ROTUNDATUS Bürger.

Pinnotheres rotundatus BÜRGER, Beitrag z. Kenntnis d. Pinnotherien Zool. Jahrb. Syst. **8** (1895) 378, pl. 9, fig. 21; pl. 10, fig. 19.

BURIAS, from the shell of *Circe*.

PINNOTHERES HOLOTHURIÆ Semper.

Pinnotheres holothuriæ C. SEMPER, Die natürlichen Existenzbedingungen der Thiere, Leipzig **1** (1880) 78, 99; BÜRGER, Zool. Jahrb. Syst. **8** (1895) 381, pl. 9, fig. 27; pl. 10, figs. 26, 36.

MINDANAO, Zamboanga Province, "Parasit in der Lunge von Stichopus variegatus, in der noch eine der mir vorliegenden Individuen eingeschlossen ist" Bürger.

PINNOTHERES FLAVUS Nauck.

Pinnotheres flavus NAUCK, Das Kaugerüst der Brachyuren, Z. Wiss. Zool. **34** (1880) 68; BÜRGER, Zool. Jahrb. Syst. **8** (1895) 383, pl. 9, fig. 29; pl. 10, figs. 29, 35.

MINDANAO, Zamboanga Province (Bürger).

Genus XANTHASIA White

XANTHASIA MURIGERA White.

Xanthasia murigera WHITE, Ann. Mag. Nat. Hist. **18** (1846) 176, pl. 2, fig. 3; DANA, U. S. Explor. Exped. Crust. **13** (1852) 384, pl. 24, fig. 6; BÜRGER, Zool. Jahrb. Syst. **8** (1895) 386, pl. 10, fig. 36.

BURIAS, 2 males and 1 female, taken from *Tridacna* (Bürger).

XENOPHTHALMINÆ

Genus XENOPHTHALMUS White

XENOPHTHALMUS PINNOTHEROIDES White.

Xenophthalmus pinnotheroides WHITE, Ann. Mag. Nat. Hist. **18** (1846) 178, pl. 2, fig. 2; ADAMS and WHITE, Zool. Voy. Samarang, Crust. (1850) 63, pl. 12, fig. 2; MILNE EDWARDS, Ann. Nat. Sci. III Zool. **20** (1853) 221; STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 107.

MINDORO, Mindoro Province, Puerto Galera, 0–1752.

XENOPHTHALMUS LATIFRONS Bürger.

Xenophthalmus latifrons BÜRGER, Beitrag z. Kenntnis d. Pinnotherien, Zool. Jahrb. Syst. **8** (1895) 387, pl. 9, fig. 32; pl. 10, fig. 32.

LUZON, Bataan Province, Mariveles. BOHOL. Bürger's collection consisted of 6 ovigerous females.

Family MICTYRIDÆ Dana

Genus MICTYRIS Latreille

MICTYRIS LONGICARPUS Latreille.

Mictyris longicarpus LATREILLE, Gen. Crust. et Ins. **1** (1806) 41; HENDERSON, Trans. Linn. Soc. London Zool. (2) **5** (1893) 390; ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 384.

Mictyris brevidactylus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1858) 99, var.

BANTAYAN, Cebu Province, 0–267. BANARAN, Sulu, 0087. PALAWAN, Iwahig, 0–33.

MICTYRIS PLATYCHELES Milne Edwards.

Mictyris platycheles MILNE EDWARDS, Ann. Sci. Nat. (3) Zool. **18** (1852) 154; MIERS, Rept. Voy. Challenger, Brachyura, Zool. **17** (1886) 279.

Mictyris subverrucatus WHITE, List. Crust. Brit. Mus. (1847) 34, Descript. nulla.

PALAWAN, Taytay, 0–1243.

MICTYRIS DEFLEXIFRONS de Haan.

Mictyris deflexifrons W. DE HAAN, in v. Siebold, Fauna Japon. Crust. (1835) 25.

CUYO, Palawan Province, 0086.

Family PALICIDÆ Rathbun

Genus PALICUS Philippi

PALICUS JUKESII (White).

Cymnopolia jukesii WHITE, in Jukes' Voy. H. M. S. "Fly" p. 338, pl. 2, fig. 2; MIERS, Rept. Voy. Challenger, Brachyura, Zool. **17** (1886) 335.

Palicus jukesii ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **69** (1900) 451.

POLILLO, Tayabas Province, 0265. The Challenger specimen was taken from a depth of 10 fathoms, south of Mindanao in 6° 54′ 0″ north latitude, 122° 18′ 0″ east longitude.

These crabs are small, having a *Dorippe* appearance. They are found among corals and resemble an eroded flake of coral rock.

The genus *Cymnopolia* was formerly placed under Dorippidæ.

Tribe OXYRHYNCHA or MAIOIDEA

Legion MARINEA [23]

INACHIDÆ

LEPTSPODINÆ

Genus ACHÆUS Leach

ACHÆUS VILLOSUS Rathbun.

Achæus villosus Rathbun, Proc. U. S. N. M. **50** (1916) 528.

Off JOLO, Jolo Light, 20 fathoms (Albatross).

INACHINÆ

(=Eurypodiidæ Stimpson)

Genus CAMPOSCIA Latreille

CAMPOSCIA RETUSA Latreille.

Camposcia retusa ADAMS and WHITE, Zool. Voy. Samarang (1850) 6; A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris **8** (1872) 256; HASWELL, Cat. Austral. Crust. (1882) 4; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. **7** (1894) 35.

GUIMARAS (Samarang).

Genus ONCINOPUS de Haan

ONCINOPUS NEPTUNUS Adams and White.

Oncinopus neptunus ADAMS and WHITE, Zool. Voy. Samarang (1850) 1, pl. 2, fig. 1.

Philippines (Samarang).

ONCINOPUS ARANEA de Haan.

Oncinopus aranea DE HAAN, Fauna Japon. (1850) 100, pl. 20, fig. 2; ADAMS and WHITE, Zool. Voy. Samarang (1850) 3.

East of MINDORO, 15 fathoms (Samarang).

Genus INACHUS Fabricius

INACHUS LORINA Adams and White.

Inachus lorina ADAMS and WHITE, Zool. Voy. Samarang, Crust. (1843) 3; A. WHITE, List Crust. Coll. Brit. Mus. (1847) 123.

Eastern shore of MINDANAO (Samarang).

[23] Miers (in Classification of the Maioid Crabs, Journ. Linn. Soc. Zool. 14 : 634–672) distinguished among the Maiinea three principal groups, founded upon the orbital and antennal characters:—(1) Inachidæ, (2) Maiidæ, and (3) Periceridæ.

Genus ECHINOPLAX Miers

ECHINOPLAX NOSELEYI Miers.

Echinoplax noseleyi MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 32, pl. 4, fig. 2.

Dredged at 9° 26′ 0″ north latitude, 123° 45′ 0″ east longitude, 375 fathoms (Challenger).

Genus ANAMATHIA Smith

(=*Amathia* Roux)

ANAMATHIA PULCHRA Miers.

Anamathia pulchra MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 26, pl. 4, fig. 1.

Dredged at 9° 26′ 0″ north latitude, 123° 45′ 0″ east longitude, 375 fathoms.

Genus PLATYMAIA Miers

PLATYMAIA BARTSCHI Rathbun.

Platymaia bartschi RATHBUN, Proc. U. S. N. M. 50 (1916) 529.

China Sea, off Southern LUZON, Matocot Point, 198 fathoms (Albatross).

PLATYMAIA REMIFERA Rathbun.

Platymaia remifera RATHBUN, Proc. U. S. N. M. 50 (1916) 530.

Between CEBU and BOHOL, Lauis Point, 175 fathoms (Albatross).

Genus CYRTOMAIA Miers

CYRTOMAIA HORRIDA Rathbun.

Cyrtomaia horrida RATHBUN, Proc. U. S. N. M. 50 (1916) 532.

APO, between NEGROS and SIQUIJOR, 256 fathoms (Albatross).

CYRTOMAIA ECHINATA Rathbun.

Cyrtomaia echinata RATHBUN, Proc. U. S. N. M. 50 (1916) 533.

PANAON, Between LEYTE and MINDANAO, San Ricardo Point, 732 fathoms.

Genus ACHAEOPSIS Stimpson

ACHAEOPSIS SULUENSIS Rathbun.

Achaeopsis suluensis RATHBUN, Proc. U. S. N. M. 50 (1916) 535.

TINAKTA, Tawitawi Group, Sulu Archipelago, 10 fathoms (Albatross).

ACANTHONYCHINÆ

Genus OXYPLEURODON Miers

OXYPLEURODON STIMPSONI Miers.

Oxypleurodon stimpsoni MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 38, pl. 6, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 43.

Dredged at 9° 26′ 0″ north latitude, 123° 45′ 0″ east longitude, 375 fathoms, blue mud bottom (Challenger).

Genus MENÆTHIUS M. Edwards

MENÆTHIUS MONOCEROS (Latreille).

Inachus arabicus RUPPELL, Krabben Roth. Meer. (1880) 24, pl. 5, fig. 4.
Menæthius monoceros MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 339; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 41.
Menæthius porcellus WHITE, Ann. Mag. Nat. Hist. (2) 2 (1848) 284.
Menæthius subserratus ADAMS and WHITE, Zool. Voy. Samarang (1850) 18, pl. 4, fig. 1.
Menæthius angustus, depressus, subserratus, areolatus, inornatus DANA, U. S. Explor. Exped. (1852) 120–125, pl. 4, figs. 5–7; pl. 5, figs. 2, 3.
Menæthius dentatus STIMPSON, Proc. Acad. Nat. Sci. Philad. (1857) 219.

Sulu Sea (Dana); Adams and White did not specify the locality.

Genus PELTINIA Dana[24]

PELTINIA SUBLIMIS Rathbun.

Peltinia sublimis RATHBUN, Proc. U. S. N. M. 50 (1916) 536.

Near JOLO, Jolo Light, 22 fathoms (Albatross).

The genus *Peltinia* is considered as synonym to *Pugettia* Dana by Miers in Classification of the Maioid Crustacea.

Genus HUENIA de Haan

HUENIA PROTEUS de Haan.

Huenia proteus DE HAAN, Crust. v. Siebold, Fauna Japon. dec. 4, p. 95, pl. 23, figs. 4, 5; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 35; Crust. Rept. Zool. Coll. of H. M. S. "Alert" (1894) 191; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 40.

MINDANAO. Eastern MINDORO (Samarang).

Genus PUGETTIA Dana

PUGETTIA MINDANAOENSIS Rathbun.

Pugettia mindanaoensis RATHBUN, Proc. U. S. N. M. 50 (1916) 538.

Off northern MINDANAO, Tagolo Light, 162 fathoms (Albatross).

PUGETTIA LEYTENSIS Rathbun.

Pugettia leytensis RATHBUN, Proc. U. S. N. M. 50 (1916) 539.

CAPITANCILLO, between LEYTE and CEBU, 182 fathoms (Albatross).

[24] Journ. Linn. Soc. Zool. 14: 650.

PISINÆ

Genus SPHENOCARCINUS A. M. Edwards [25]

SPHENOCARCINUS LUZONICUS Rathbun.

Sphenocarcinus luzonicus RATHBUN, Proc. U. S. N. M. 50 (1916) 540.

BATAG, Atalaya Point, east coast of Luzon, 308 fathoms (Albatross).

SPHENOCARCINUS AURITUS Rathbun.

Sphenocarcinus auritus RATHBUN, Proc. U. S. N. M. 50 (1916) 540.

BATAG, Atalaya Point, east coast of Luzon, 308 fathoms (Albatross).

SPHENOCARCINUS NODOSUS Rathbun.

Sphenocarcinus nodosus RATHBUN, Proc. U. S. N. M. 50 (1916) 541.

APO, between NEGROS and SIQUIJOR, 279 fathoms (Albatross).

MICRORHYNCHINÆ

Genus DOCLEA Leach

DOCLEA CALCITRAPA White.

Doclea calcitrapa A. WHITE, Zool. Soc. London 15 (1847) 56; WHITE, "Samarang" Crust. (1848) 7.

LUZON, Manila Bay, 0186. CEBU (Samarang).

Family MAIIDÆ Miers

Subfamily MAIINÆ Miers

Genus HYATENUS White [26]
(= *Chorilia* Dana)

HYASTENUS TRISPINOSUS Rathbun.

Hyastenus trispinosus RATHBUN, Proc. U. S. N. M. 50 (1916) 542.

TINAKTA, Sulu Archipelago, Tawitawi Group, 10 fathoms (Albatross).

HYASTENUS AUCTUS Rathbun.

Hyastenus auctus RATHBUN, Proc. U. S. N. M. 50 (1916) 543.

Near SIASI, Sulu Archipelago, SIRUM, 17 fathoms (Albatross).

HYASTENUS TUBERCULOSUS Rathbun.

Hyastenus tuberculosus RATHBUN, Proc. U. S. N. M. 50 (1916) 543.

Near JOLO, Jolo Light, 29 fathoms (Albatross).

[25] The Genus *Sphenocarcinus* is placed by Miers (Journ. Linn. Soc. 14: 663) under subfamily Pericerinæ of the Family Periceridæ. The classification followed here is that of Rathbun.

[26] Rathbun (in Proc. U. S. N. M. 50) placed the genera *Hyastenus*, *Chorilia*, and *Naxioides* under Subfamily Pisinæ under Family Inachidæ. She also included in this family the Subfamily Schizophrysinæ and hence the genera *Maja* and *Leptomithrax*. All of these genera were placed by Miers in the Family Maiidæ. Journ. Linn. Soc. Zool. 14.

HYASTENUS ORBIS Rathbun.

Hyastenus orbis RATHBUN, Proc. U. S. N. M. 50 (1916) 544.

OBSERVATION, Tawitawi Group, Sulu Archipelago, 9 fathoms (Albatross).

HYASTENUS BIFORMIS Rathbun.

Hyastenus biformis RATHBUN, Proc. U. S. N. M. 50 (1916) 545.

TINAKTA, Tawitawi Group, Sulu Archipelago, 10 fathoms (Albatross).

HYATENUS FRATERCULUS Rathbun.

Hyastenus fraterculus RATHBUN, Proc. U. S. N. M. 50 (1916) 546.

OBSERVATION, Tawitawi Group, Sulu Archipelago, 9 fathoms (Albatross).

HYASTENUS SCROBICULATUS Rathbun.

Hyastenus scrobiculatus RATHBUN, Proc. U. S. N. M. 50 (1916) 547.

TINAKTA, Tawitawi Group, Sulu Archipelago, 12 fathoms (Albatross).

HYASTENUS TINAKTENSIS Rathbun.

Hyastenus tinaktensis RATHBUN, Proc. U. S. N. M. 50 (1916) 547.

TINAKTA, Tawitawi Group, Sulu Archipelago, 10 fathoms (Albatross).

HYASTENUS DIACANTHUS (de Haan).

Naxia diacantha DE HAAN, v. Siebold, Crust. Fauna Japon. (1839) 96, pl. 21, fig. 1.

Pisa (*Naxia*) *diacantha* DE HAAN, Fauna Japon. (1850) 96, pl. 24, fig. 1.

Hyastenus diacanthus A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 8 (1872) 250; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 55.

Dredged at 11° 37′ 0″ north latitude, 123° 31′ 0″ east longitude, 18 fathoms, blue mud bottom (Challenger).

HYASTENUS ORYX A. M. Edwards.

Hyastenus oryx A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. 8 (1872) 250, pl. 14, fig. 1; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 58.

Dredged together with *H. diacanthus*.

HYASTENUS SEBÆ White.

Hyastenus sebæ ADAMS and WHITE, Zool. Voy. Samarang (1850).

Philippines (Samarang).

HYASTENUS ELEGANS Miers.

Hyastenus elegans MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 58, pl. 6, fig. 3.

MINDORO, Mindoro Province, Puerto Galera, 0–565. LUZON, Allbay Province, 0–1473.

Genus CHORILIA Dana [27]

CHORILIA SPHENOCARCINOIDES Rathbun.

Chorilia sphenocarcinoides RATHBUN, Proc. U. S. N. M. 50 (1916) 548.

[27] Journ. Linn. Soc. Zool. 14.

APO, between NEGROS and SIQUIJOR, 279 fathoms (Albatross).

Miers [28] recognized *Chorilia* as a subgenus under *Hyastenus*.

Genus NAXIOIDES A. M. Edwards

NAXIOIDES ROMBLONI Rathbun.

Naxioides rombloni RATHBUN, Proc. U. S. N. M. 50 (1916) 549.

Near ROMBLON, Romblon Light, 37 fathoms, hard sand bottom (Albatross).

Genus PHALANGIPUS

PHALANGIPUS FILIFORMIS Rathbun.

Phalangipus filiformis RATHBUN, Proc. U. S. N. M. 50 (1916) 551.

East of LEYTE, Tacbuc Point, 57 fathoms (Albatross).

PHALANGIPUS RETUSUS Rathbun.

Phalangipus retusus RATHBUN, Proc. U. S. N. M. 50 (1916) 552.

TINAKTA, Tawitawi Group, Sulu Archipelago, 18 fathoms, fine sand bottom (Albatross).

Genus PISA Leach

PISA SINOPE Adams and White.

Pisa sinope ADAMS and WHITE, Zool. Samarang, Crust. (1848) 8.

Philippines (Samarang).

Genus EGERIA Leach

(= *Leptopus* Lamarck)

EGERIA ARACHNOIDES (Rumphius).

Cancer arachnoides RUMPHIUS, D' Amboinische Rariteitkamer (1741) pl. 8, fig. 4.

Egeria indica LEACH, Zool. Miscell. 2 (1815), pl. 73.

Egeria arachnoides MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 291; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 44.

Dredged at 6° 54′ 0″ north latitude, 122° 18′ 0″ east longitude, 10 fathoms (Challenger).

EGERIA LONGIPES (=E. Herbstii) M. Edwards.

CEBU (Samarang). Rathbun believed this is identical with *Phalangipus retusus*, the new species she created in Proc. U. S. N. M. 50 : 532.

Genus NAXIA M. Edwards

(= *Naxioides* A. M. Edwards; *Podopisa* Hilgendorf)

NAXIA HIRTA (A. M. Edwards).

? *Naxioides hirta* A. M. EDWARDS, Ann. Soc. Entom. France III 5 (1865) 143, pl. 4, figs. 1.

Naxia hirta MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 61.

MINDANAO, Zamboanga Province, 15 fathoms (Challenger).

[28] Journ. Linn. Soc. 14.

Subfamily MICIPPINÆ Miers

Genus MICIPPA Leach

MICIPPA PHILYRA (Herbst).

Micippa philyra M. EDWARDS, Hist. Nat. Crust. 1 (1884) 330; ADAMS and WHITE, Zool. Voy. Samarang (1850) 15; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 59.

Miccipa hirtipes DANA, U. S. Explor. Exped. Crust. (1852) 90, pl. 1, fig. 4.

GUIMARAS (Samarang).

MICIPPA BICARINATA Adams and White.

Micippa bicarinata ADAMS and WHITE, Zool. Voy. Samarang (1850) 16.

CEBU. LUZON (Samarang). Ortmann believed this species to be identical with *M. philyra.*

MICIPPA CRISTATA (Linnæus).

Micippa cristata MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 330; ADAMS and WHITE, Zool. Voy. Samarang (1850) 16; MIERS, Ann. Mag. Nat. Hist. (5) 15 (1885) 4; ORTMANN, Decapod. Krebse Strassburger Mus. Zoöl. Jahrb. Syst. 7 (1894) 59.

LUZON, Albay Province, Magallanes, 0189. SIQUIJOR. CEBU.

Subfamily SCHIZOPHRYSINÆ Miers[29]

Genus MAJA Bosc

MAJA SULUESIS Rathbun.

Maja suluensis RATHBUN, Proc. U. S. N. M. 50 (1916) 552.

Tawitawi Group, Sulu Archipelago. OBSERVATION, 9 fathoms (Albatross).

MAJA LINAPACANENSIS Rathbun.

Maja linapacanensis RATHBUN, Proc. U. S. N. M. 50 (1916) 553.

OBSERVATORY, Linapacan Strait, 46 fathoms (Albatross).

MAJA BISARMATA Rathbun.

Maja bisarmata RATHBUN, Proc. U. S. N. M. 50 (1916) 554.

Off northern MINDANAO, Point Tagolo Light, 182 fathoms (Albatross).

Genus LEPTOMITHRAX Miers[30]

LEPTOMITHRAX SINENSIS Rathbun.

Leptomithrax sinensis RATHBUN, Proc. U. S. N. M. 50 (1916) 555.

China Sea near southern LUZON, 88 fathoms. Miers considers this a subgenus of *Paramithrax.*

[29] Rathbun placed the Subfamily Schizophrysinæ in the Family Inachidæ and subsequently transferred the genera of this Subfamily from Maiidæ to the Family Inachidæ. Mier's classification is followed in this paper.

[30] Journ. Linn. Soc. Zool. 14.

Genus SCHIZOPHRYS White

(= *Dione* de Haan, nom. praeocc.)

SCHIZOPHRYS SPINEGER Adams and White.

Schizophrys spineger ADAMS and WHITE, Zool. Voy. Samarang (1850).

SIQUIJOR. BOHOL (Samarang).

Genus PARAMITHRAX M. Edwards

PARAMITHRAX EDWARDSII de Haan.

Paramithrax edwardsii ADAMS and WHITE, Zool. Voy. Samarang (1850).

Philippines (Samarang).

Family PERICERIDÆ Miers

Subfamily PERICERINÆ Stimpson

Genus PERICERA Latreille

PERICERA TIARATA Adams and White.

Pericera tiarata ADAMS and WHITE, Zool. Voy. Samarang Crust. (1848) 17.

Philippines (Samarang).

PERICERA SETIGERA Adams and White.

Pericera setigera ADAMS and WHITE, Zool. Voy. Samarang Crust. (1848) 17.

Philippines (Samarang).

PERICERA CORNIGERA H. M. Edwards.

Pericera cornigera H. M. EDWARDS, Roret's Suite a Buffon Crustaces 1 (1834).

Genus TIARINIA Dana

TIARINIA GRACILIS Dana.

Tiarinia gracilis DANA, U. S. Explor. Exped. Crust. (1852) 111, pl. 3, fig. 6; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 62.

Sulu Sea (Dana). Ortmann believed this species to be identical with *Pericera tiarata* of Adams and White.

Subfamily MITHRACINÆ Stimpson

Genus MITHRAX Leach

MITHRAX DICHOTOMUS Latreille.

Mithrax dichotomus A. G. DESMAREST, Consid. gen. Crust. (1825) 150.

MINDORO, Mindoro Province, Calapan, 0190.

Legion PARTHENOPINEA Dana

PARTHENOPIDÆ [31]

PARTHENOPINÆ

Genus PARTHENOPE Fabricius

PARTHENOPE (LAMBRUS) VALIDA v. Siebold.

Parthenope (Lambrus) valida v. SIEBOLD, Fauna Japon. Crust. (1839) 90, pl. 21, fig. 1; pl. 22, fig. 1.

From the shores of Mindoro, Ilocos Sur, LUZON. Sandy bottom.

PARTHENOPE (RHINOLAMBRUS) RUDIS Rathbun.

Parthenope (Rhinolambrus) rudis RATHBUN, Proc. U. S. N. M. **50** (1916) 556.

OBSERVATION, Tawitawi Group, Sulu Archipelago, 9 fathoms (Albatross).

PARTHENOPE (PSEUDOLAMBRUS) PARVA Rathbun.

Parthenope (Pseudolambrus) parva RATHBUN, Proc. U. S. N. M. **50** (1916) 557.

TINAKTA, Tawitawi Group, Sulu Archipelago, 10 fathoms (Albatross).

Genus CRYPTOPODIA Milne Edwards

CRYPTOPODIA DORSALIS Adams and White.

Cryptopodia dorsalis A. WHITE, List Crust. Coll. Brit. Mus. (1847) 125; WHITE and ADAMS, Proc. Zool. Soc. London **15** (1847) 125; Zool. Voy. Samarang, Crust. (1848) 30.

JOLO, Sulu Sea, 20 fathoms, stony bottom (Samarang).

Genus DALDORFIA Linnæus

DALDORFIA HORRIDA (Linnæus).

Cancer horridus LINNÆUS, Nat. 11, 1047, 43.

Parthenope horrida ALCOCK, Carc. Fauna India, Journ. Asiat. Soc. Bengal **63–64** (1894–95) 279.

Daldorfia horrida RATHBUN, Brachyura and Macrura of Hawaiian Islands, Bul. Fish Comm., p. 886, pl. 14, fig. 9.

CEBU, Cebu Province, Sibonga, 0–1773. MINDORO, Mindoro Province, Calapan, 0191.

Genus LAMBRUS Leach

LAMBRUS INTERMEDIUS Miers.

Lambrus intermedius MIERS, Proc. Zool. Soc. London (1879) 30; MIERS, Rept. Voy. Challenger, Brachyura, Zool. **17** (1886) 96, pl. 10, fig. 4.

MINDORO, Mindoro Province, Puerto Galera, 0–191.

[31] Miers (in Classification of the Maioid Crust. Journ. Linn. Soc. **14**) subdivided the Family Parthenopidæ into two subfamilies: (1) Parthenopinæ, (2) Eumedoninæ.

LAMBRUS TURRIGER White.

Lambrus turriger WHITE, Proc. Zool. Soc. London (1847) 58; ADAMS and WHITE, Crust. Samarang (1848) 26, pl. 5, fig. 2; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 96.

Philippines (Samarang).

LAMBRUS PISOIDES Adams and White.

Lambrus pisoides MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 98.

Philippines (Samarang).

LAMBRUS SERRATUS M. Edwards.

Lambrus serratus M. EDWARDS, Hist. Nat. Crust. 1 (1834) 357; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 97.

CORREGIDOR (Samarang).

LAMBRUS CONTRARIUS (Herbst).

Cancer contrarius HERBST, Naturgesch. Krabben u. Krebse Heft 4 4 (1804) 8, pl. 60, fig. 3.

Lambrus contrarius M. EDWARDS, Hist. Nat. Crust. 1 (1834) 354; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 94.

MINDANAO, Zamboanga Province, 10 fathoms (Challenger).

LAMBRUS LAMELLIFRONS Adams and White.

Lambrus lamellifrons ADAMS and WHITE, Zool. Voy. Samarang, Crust. (1848) 26.

Philippines (Samarang).

LAMBRUS (PARTHENOLAMBRUS) CALAPPOIDES (Adams and White).

Parthenope calappoides ADAMS and WHITE, Crust. Zool. Samarang (1848) 34, pl. 5, fig. 5; MIERS, Crust. Rept. Zool. Coll. H. M. S. Alert (1864) 527.

Lambrus (*Parthenolambrus*) *calappoides* MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 101.

Philippines (Challenger).

LAMBRUS LONGIMANUS (Linnæus).

Lambrus longimanus LEACH, Trans. Linn. Soc. London 11 (1815) 310; MILNE EDWARDS, Hist. Nat. Crust. 1 (1834) 354; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 95.

Philippines (Samarang).

LAMBRUS PELAGICUS Ruppell.

Lambrus pelagicus RUPPELL, 24 Krabben Roth. Meer. (1830) 15, pl. 4, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 414.

Lambrus affinis A. M. EDWARDS, Nouv. Archiv. Mus. Hist. Nat. Paris 8 (1872) 261, pl. 14, fig. 4; HASWELL, Cat. Austral. Crust. (1882) 34.

CEBU (Thallwitz).

Family EUMEDOMIDÆ Ortmann

Subfamily EUMEDOMINÆ Miers

Genus ZEBRIDA White

ZEBRIDA ADAMSI White.

Zebrida adamsi WHITE, Proc. Zool. Soc. London (1847) 121; ADAMS and WHITE, Zool. Voy. Samarang (1850) 24, pl. 7, fig. 1; ORTMANN, Decapod. Krebse Strassburger Mus. Zool. Jahrb. Syst. 7 (1894) 419.

Sulu Sea (Ortmann).

Genus CERATOCARCINUS Adams and White

CERATOCARCINUS LONGIMANUS Adams and White.

Ceratocarcinus longimanus ADAMS and WHITE, Proc. Zool. Soc. London (1847) 57; Crust. Zool. Voy. Samarang (1848) 34, pl. 6, fig. 6; MIERS, Rept. Voy. Challenger, Brachyura, Zool. 17 (1886) 105; H. A. ROXAS, Puerto Galera, Marine Biol. Lab. Rept. (1930) 18.

MINDORO, Mindoro Province, Puerto Galera. The specimen is no longer extant.

Genus HARROVIA Adams and White [32]

HARROVIA ALBO-LINEATA Adams and White.

Harrovia albo-lineata Adams and White, Zool. Voy. Samarang, Crust. (1849) 56.

Philippines (Samarang).

[32] This genus was wrongly placed by Adams and White with the Leucosidae. By Stimpson, it was considered synonymous with Ceratocarcinus; but it is as distinct as any other group.—MIERS, Classification of the Maioid Crust. Journ. Linn. Soc. Zool. 14.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

ALTMAN, L. C. Oligochaeta of Washington. (Publications in biology, v. 4, no. 1.) Seattle, University of Washington, 1936. 137 pp., plates. Price, paper, $0.75.

American institute of mining and metallurgical engineers. Petroleum division. Petroleum development and technology, 1936. (Transactions of the American Institute of mining and metallurgical engineers, v. 118.) New York, The Institute, 1936. 536 pp., illus. tables, diagrs. Price, $5.

BEAUMONT, WILLIAM. Infra-red irradiation. London, H. K. Lewis & Co., 1936. 139 pp., illus. Price, 6s. 6d.

California medical association. Cancer commission. Committee studies. San Francisco, California, J. W. Stacey, 1936. 123 pp., tables.

The Chemists' year book, 1936. Manchester, Sherratt & Hughes, 1936. 1,257 pp., tables. Price, 21s.

CLARKE, G. R. The study of the soil in the field. Oxford, Clarendon press, 1936. 142 pp., tables, diagrs. Price, 5s.

CRAIGS, ELIZABETH. Economical cookery; containing over 650 economical recipes, especially selected for making the most of inexpensive foods. London and Glasgow, Collins, 1934. 252 pp. Price, 1s.

FARQUHARSON, W. I. Topography with an appendix on magnetic observations. British museum (Natural history) Scientific reports, v. 1, no. 2. John Murray expedition, 1933–34. London, The British museum, 1936. 19 pp., plates, charts. Price, 7s. 6d.

FARRAN, G. P. Copepoda. British museum (Natural history) Scientific reports, v. 4, no. 3. Great Barrier reef expedition, 1928–29. London, The British museum, 1936. 70 pp., illus., figs. Price, 5s.

FAWCETT, WILLIAM. Flora of Jamaica; containing descriptions of the flowering plants known from the island, by William Fawcett and Alfred B. Rendle. Vol. VII. Dicotyledons families Rubiaceae to Compositae, by the late Spencer Le Marchant Moore and A. B. Rendle. London, The Trustees of the British museum, 1936. 303 pp., illus. Price, 15s.

FERGUSON, R. W. Training in industry; a report embodying the results of inquiries conducted between 1931 and 1934 by the Association for education in industry and commerce. London, Pitman & sons, 1935. 156 pp. Price, 6s.

GARDNER, G. B. Keris and other Malay weapons. Singapore, Progressive pub. co., 1936. 138 pp., illus. Price, 6s. 6d.

GATER, B. A. R. Aids to the identification of anopheline imagines in Malaya. Singapore, Govt. print. off., 1935. 242 pp., illus., plates. Price, paper, $1.

GESCHICKTER, C. F., and M. M. COPELAND. Tumors of bone (including the jaws and joints). rev. ed. New York city, The American Journal of Cancer, 1936. 832 pp., illus., tables, chart. Price, $6.

GLENNIE, E. A. A report on the values of gravity in the Maldive and Laccadive Islands. British museum (Natural history) Scientific reports, v. 1, no. 4. John Murray expedition, 1933–34. London, The British museum, 1936. 13 pp., plate, charts. Price, 2s. 6d.

GRAY, L. C. Land planning. Chicago, The University of Chicago press, 1936. 37 pp. Price, $0.25.

GUMPERT, MARTIN. Trail-blazers of science; life stories of some half-forgotten pioneers of modern research. Tr. from the German by Edwin L. Shuman. New York, Funk & Wagnalls co., 1936. 306 pp. Price, $2.50.

HAMMOND, T. E. Vitality and energy in relation to the constitution. London, H. K. Lewis & co., 1936. 314 pp. Price, 12s. 6d.

HOLT, J. B. German agricultural policy, 1918–1934; the development of a national philosophy toward agriculture in postwar Germany. Chapel Hill, The University of North Carolina press, 1936. 240 pp., tables, maps. Price, $2.50.

HUXLEY, J. S., and A. C. HADDON. We Europeans; a survey of "Racial" problems, with a contribution by A. M. Carr-Saunders. New York, Harper & brothers, 1936. 246 pp., plates, tables, maps. Price, $2.50.

JONES, G. N. A botanical survey of the Olympic Peninsula, Washington. (Publications in biology, v. 5) Seattle, University of Washington, 1936. 286 pp., plates, tables, map. Price, paper, $2.

KANEHIRA, RYOZO. Formosan trees indigenous to the island. Taihoku, Formosa, Dept. of forestry, Government research institute, 1936. 574 pp., illus., plates.

KLAR, M. VON. Fabrikation von absolutem alkohol zwecks verwendung als zusatzmittel zu motor-treibstoffen. Halle (Saale), Verlag von Wilhelm Knapp, 1936. 84 pp., diagrs. Price, paper, RM. 4.20.

LETHBRIDGE, T. C. comp. Cemetery at Shudy Camps, Cambridgeshire; report of the excavation of a cemetery of the Christian Anglo-Saxon period in 1933. (Cambridge antiquarian society. Quarto publications, n. s. no. 5.) Bowes, 1936. 41 pp., illus. Price, paper, 5s.

MCKEOWN, K. C. Spider wonders of Australia. Australia, Angus & Robertson, 1936. 270 pp., front., plates. Price, 6s.

MALINIAK, J. W. Sculpture in the living; rebuilding the face and form by plastic surgery. New York, Romaine Pierson, 1934. 203 pp., illus., plates. Price, $3.

MALTZ, MAXWELL. New faces—new futures; rebuilding character with plastic surgery. New York, R. R. Smith, 1936. 315 pp., illus. Price, $3.

MENZIES-KITCHIN, A. W. Land settlement; a report prepared for the Carnegie United Kingdom trustees. T. Edinburgh and A. Constable, 1935. 175 pp., tables, diagrs.

National geographic society, Washington, D. C. Our insect friends and foes and spiders; a series of fascinating stories of bee, ant, beetle, bug, butterfly, moth, and spider life. Washington, D. C. The Society, 1935. 252 pp., illus. Price, $2.50.

PHIFER, L. D. Seasonal distribution and occurrence of planktonic diatoms at Friday Harbor, Washington. (Publications in oceanography, v. 1, no. 2.) Seattle, University of Washington, 1933. 41–81 pp., tables, diagrs., map. Price, paper, $0.35.

PHILLIPS, W. W. A. Manual of the mammals of Ceylon. Ceylon, The Director, Colombo Museum. London, Dulau & co., 1935. 373 pp., illus., plates. Price, Rs. 10s; in England, 15s.

PLIMMER, R. H. A., and V. G. PLIMMER. Food, health, vitamins. 7th ed. London, Longmans, Green & co., 1936. 178 pp., front., tables, diagrs. Price, 3s. 6d.

RECORD, G. L. How to abolish poverty. Jersey City, N. J. The G. L. Record memorial association, 1936. 201 pp., front. Price, $1.

ROBERTS, A. M. Mechanical tests for engineering materials. London, The Draughtsman publishing co., 1935–36. 89 pp., illus., tables, diagrs. Price, 4s.

SANGER, MARGARET. Happiness in marriage. New York, Blue ribbon books, 1934. 231 pp. Price, $2.

SANGER, MARGARET. Motherhood in bondage. New York, Brentano's publishers, 1928. 446 pp. Price, $3.

SANGER, MARGARET. My fight for birth control. New York, Farrar & Rinehart, 1931. 360 pp., plates. Price, $3.

SANGER, MARGARET. Woman and the new race. New York, Blue ribbon books, 1920. 234 pp., front. Price, $1.

SCHARFF, J. W. Drainage et aménagements hydrauliques divers contre le paludisme. Traduction francaise, par Henry G. S. Morin & P. Moreau. Hanoi, Imprimerie d'Extreme-Orient, 1936. 160 pp., illus., tables.

SEWELL, R. B. S. An account of Addu Atoll. British museum (Natural history) Scientific reports, v. 1, no. 3.) John Murray expedition, 1933–34. London, The British museum, 1936. 31 pp., plates. Price, 5s.

SEWELL, R. B. S. An account of Horsburgh or Goifurfehendu Atoll. British museum (Natural history) Scientific reports, v. 1, no. 5. John Murray expedition, 1933–34. London, The British museum, 1936. 17 pp., plates. Price, 2s. 6d.

STONE, H. M. Contraceptive practices. Three reprints from "The Practice of Contraception"; an international symposium and survey, ed. by Margaret Sanger and Hannah M. Stone. Baltimore, Williams & Wilkins, 1933. 32 pp., illus. Price, $0.50.

TAYLOR, C. N. Odyssey of the Islands. New York, C. Scribner's sons, 1936. 234 pp., frontis., illus., plates. Price, $3.

Trinidad. Imperial college of tropical agriculture. Cacao research. Fifth annual report, 1936. Trinidad, printed by the Govt. print., 1936. 55 pp., plates, tables. Price, $1.25.

Wellcome foundation, limited, London. Spanish influence on the progress of medical science, with an account of the Wellcome research institu-

tion and the affiliated research laboratories and museums founded by Sir Henry Wellcome; commemorating the tenth International congress of the history of medicine held at Madrid, 1935. London, The Foundation, 1935. 121 pp., illus. gratis.

WOLF, F. A. Tobacco diseases and decays. Durham, North Carolina. Duke University press, 1935. 454 pp., illus. Price, $5.

REVIEWS

The Advance of Science. Edited by Watson Davis. Doubleday, Doran and Co., Garden City, New York, 1934. 400 pp., illus. Price, $3.50.

This book contains reviews of recent developments in various branches of science. Unpuzzling the universe or the latest in astronomy, stratosphere flights, glands and their hormones, polar explorations, fighting disease, archælogical and anthropological investigations, and chemical discoveries, are some of the subjects discussed. The book is not only instructive but also very interesting. It is written in a popular style and can therefore readily be understood by the layman.—A. P. W.

The Algae and Their Life Relations; Fundamentals of Phycology. By Josephine E. Tilden. Humphrey Milford, Oxford University press, London: The University of Minnesota press, Minneapolis, Minnesota, 1935. 550 pp., illus. Price, $5.

Insofar as it presents its materials in an orderly fashion, this book will do duty as a guide to the student and teacher of phycology, a subject on which there has long been a need for an adequate textbook suitable for classroom use. Several features of the book, however, make one hesitate to recommend it to the uncritical user. For instance, in discussing the evolution and interrelationship of the algæ, the author gives the hypothesis that the various classes evolved under gradually changing conditions of illumination and in relation to a progressive invasion of the shallower waters and the littoral zone of a primeval ocean. But one can hardly find anything in the book that would back up such a contention. Moreover, in speaking of sexual reproduction in Rhodophycæ on p. 101 she merely says that "it probably appeared in plants for the first time." With respect to this and other phases of her subject the uncertainty of the author is evident. Brushing aside, however, these few drawbacks of the book, it contains a good deal of useful information for the discriminating reader.—E. Q.

The Bacteriology of Typhoid, Salmonella, and Dysentery Infections and Carrier States. By Leon C. Havens. Humphrey Milford, Oxford University Press, London: The Commonwealth Fund, New York, 1935. 158 pp. Price, $1.75.

This publication is perhaps the most complete treatise available at present on enteric pathogens. It deals in a very elaborate manner with the laboratory procedures that have been found useful in the diagnosis of intestinal infections and carrier states. It is recommended to all bacteriologists and physicians for their guidance in solving their problems regarding enteric diseases.
—M. B.

Constructive Eugenics and Rational Marriage. By Morris Siegel. McClelland and Stewart, Ltd., Toronto, 1934. 196 pp. Price, $2.50.

This book is a welcome exposition of the young science of eugenics not yet well understood by many people. The simplicity of its language makes it attractive as well as interesting and instructive to lay readers. The need for instruction in heredity is apparent, for even in our modern medical schools this subject is barely touched upon. This volume will contribute greatly to the enlightenment of the younger generations as to their responsibility and part in the improvement of the race. The plan advocated under constructive eugenics is sane and worthy of further thought and study by educators, social workers, and health officers. Its local application will be a step forward in the betterment of the race. Professionals as well as parents will profit a great deal by its perusal.—U. D. M.

Diet and Die. By Carl Malmberg. Hillman-Curl, Inc., New York City, 1935. 149 pp. Price, $1.50.

This book is a startling revelation of the different diet fads and medicinal frauds that are now found in the market and are ruining the health of thousands of young girls. These unfortunate beings, in order to follow fashion, subject themselves to these fads and try to live on a diet which is not compatible with good health. In this book one will find many popular diets in vogue in America, criticized severely and their inconsistencies and dangers clearly presented. This book can be strongly recommended to young women in any country who are contemplating reducing treatment.—I. C.

The Frustration of Science. By Sir Daniel Hall and others. Foreword by Frederick Soddy. George Allen and Unwin, Ltd., London, 1935. 144 pp. Price, 3s. 6d.

This little book contains a number of scientific essays written by various English authors. In general these authors contend that the constructive aims of science have not been fully applied.

The most striking fact about the present-day world is the contrast between the vast possibilities of prosperity and the ap-

palling poverty of the majority of the population. Industry and science have made such huge advances that a large improvement in the standard of life, particularly of the workers, is now technically and immediately possible. But the social and economic structure of our western world is clearly of such a kind that we are unable at present to take full advantage of the technical progress which we have already achieved.

In addition to a foreword by Professor Frederick Soddy the book contains seven chapters with titles as follows: Science and Agriculture, Aviation, Science and Industry, Medicine, the Invention of Sterility, Bacterial Warfare, and the Frustration of Science.

These essays are quite interesting, and the criticisms that are brought out are worthy of serious consideration.—J. M.

An Introduction to Sex Education. By Winifred V. Richmond. Farrar and Rinehart, Inc., New York, 1934. 312 pp. Price, $2.50.

An Introduction to Sex Education is a comprehensive treatise on sex, written in simple and understandable language. The manifestations of sex among primitive peoples as compared to those among the civilized are brought out interestingly in this work. The book also gives a historical contrast of the question of sex in ancient times and in our modern age. Many will find the book not only interesting and entertaining, but also instructive. It helps in the study of sex from the social, economic, and educational standpoint.—U. D. M.

Manual of the Mammals of Ceylon. By W. W. A. Phillips. The Director, Colombo Museum, Ceylon: Dulau and Co., Ltd., London, 1935. 373 pp., plates, map, text figs. Price, Rs. 10, in England, Rs. 15.

This publication is the result of the author's long experience in the observation, collection, and study of the land mammals of Ceylon. A brief sketch of the historical geology of the island gives a good background of the evolution, migration, and distribution of species. A map of the island shows the main tracts of mammals, an important factor to species and subspecies formation. Nine orders with 23 families and 109 forms of mammals are treated. A key for the separation of higher into lower groups is given, and descriptions of groups are supplied whenever necessary. The trinomial has been freely used. An almost consistent arrangement of the annotations in the enumeration of the races has been followed, thus: scientific name, common English name, synonyms, popular (mostly vernacular) names, description, distribution, food, breeding, and habits.

The book is profusely illustrated; many of the pictures were taken from nature. A list of 43 references constitute the bibliography. This book is an important contribution to the fauna of Oriental regions, where work of this nature is greatly needed.—C. G. M.

The 1935 Year Book of the Eye, Ear, Nose, and Throat. The Eye, edited by E. V. L. Brown and Louis Bothman; The Ear, Nose, and Throat edited by G. E. Shambaugh and E. W. Hagens, with collaboration of G. E. Shambaugh, Jr. The Year Book Publishers, Inc., Chicago, Ill., 1935. 638 pp., illus. Price, cloth, $2.50.

This volume is one of the ten Practical Medicine Year Books, which now are in their thirty-fifth year.

In order to acquaint the busy specialist with recent advances in Ophthalmology and Otorhinolaryngology, the editors, as in previous volumes, have made concise but very comprehensive abstracts of articles on these subjects that appeared in 1935 in well-known journals all over the world. The references of these articles are given in the footnotes. One great value of this volume is the frank opinion and appreciation of the editors regarding certain articles abstracted, advising readers with regard to accepting the results of investigations thereon with caution.

It is highly recommended that every one practising this specialty should make it a point to have the Year Book every year in order to be well posted on recent and important advances.

—A. S. F.

Otosclerosis. By Louis K. Guggenheim. St. Louis, Missouri, 1935. 212 pp., illus. Price, cloth, $6.

Many theories have been offered on the etiology of otosclerosis. For over fifty years this condition has been the subject of intensive scientific investigation and philosophic consideration, but unfortunately we are still in the dark regarding its etiology.

The results of the investigations of Dr. Louis K. Guggenheim, done at the Oscar Johnson Institute, and his theory regarding the etiology of otosclerosis as discussed in the volume, should therefore be welcomed by the medical profession. The book contains six chapters: In the introduction the author makes critical comments and an excellent summary of the well-known theories of the etiology of this serious ear affection. In the second chapter he discusses in a very lucid manner his theory of regression.

The other chapters deal with phylogenesis, ontogenesis, pathogenesis, and pathogenesis and autopsis. Clear microphotographs and excellent illustrations add greatly to the value of the book.—A. S. F.

Petroleum Development and Technology, 1936. (Transactions of the American Institute of mining and metallurgical engineers, v. 118). The American Institute of Mining and Metallurgical Engineers, New York, 1936. 536 pp., illus., tables, diagrs. Price, $5.

The present volume of the Transactions, Petroleum Development and Technology, 1936, consists of 536 pages and contains papers and production statistics presented in the meeting held in Houston, Texas, and in the annual meeting in New York. Interesting papers on the estimation of oil reserves are given. Other papers included deal with various phases of production and research engineering, covering the latest developments of the petroleum industry of the United States.—F. D. R.

Physicians' and Surgeons' Textbook on Endocrinology and Ready Reference Therapy. By Theodore H. Larson. Chicago College of endocrinology, Los Angeles, Calif., 1934. 870 pp. Price, $10.

This book contains a detailed study of the thirteen hormones of men. Each hormone is discussed from its physiology, pathological physiology, etiology, symptomatology, and diagnosis to therapy and prognosis. Various physical make-ups are illustrated with pictures and their hormonal relative and exchange values are given.

The last part of the book deals with diseases and their hormone treatment. This part is interesting. Hormone therapy seems reasonable although its efficacy and practicability look doubtful. For instance, which market is now selling the master hormone or the isolated splenic hormone?—I. F.

The Practice of Ionization. By J. Newton Dyson. Henry Kimpton, London, 1936. 178 pp., illus. Price, 6s.

This is a concise, brief book on the uses of the galvanic current in the treatment of different diseases. It defines the word "ionization" as the "movement of ions" taking place in an electrolyte resulting from the passage of the galvanic current through it.

The book begins with the discussion of the elementary principles of the electric current, then proceeds to the apparatus from which the current may be obtained and later to the method of its application. There is a chapter on "Ionization." The rest of the book treats of the clinical application of "ionization,"

giving the results of the treatment according to the experience of the author. Some of the diseases in which this kind of electrical treatment may be of benefit are arthritis, deafness, and tinnitus, resulting from chronic otitis media and otosclerosis, fibrositis, sciatica, paralysis from cerebral and spinal lesions, neuritis, Raynaud's disease, and some forms of dermatosis and gynecological conditions, exophthalmic goitre, mucous colitis, rectal fistula and pyorrhea.—A. P. W.

School Education in Hygiene and Sex; Lectures Given at Felsted School. By G. O. Barber. W. Heffer and Sons Ltd., Cambridge, England, 1936. 71 pp. Price, 2s. 6d.

These lectures attempt a rather superficial discussion of the make-up and physiology of the human body. The question of sex is brought out in a most natural and simple way. The chapter on venereal diseases and how they are acquired is the most valuable part of the book. The young and innocent are made aware of the sufferings caused by these diseases. To parents, teachers, and students, this book will serve as a useful guide in keeping the body healthy. There is, however, one thing the author failed to include in his book and that is how to overcome or curb strong sexual instincts through education, athletics, harmless pastimes, and by other means.—I. F.

Sex. By B. P. Wiesner. (The Home University Library of Modern Knowledge.) Thornton Butterworth Ltd., London, 1936. 251 pp. Price, $0.75.

This interesting little book takes up the study of sex in animals. The scientific observations of sex behavior in various kinds of animals are of interest to the biologist, anatomist, and other scientists. The "differentiation of sex in the embryo" and "The mechanism of the determination of sex" are taken up exhaustively.

The book has not been proof-read properly as there are in the text, in parentheses, numerous references to pages and figures that are entirely lacking.—U. D. M.

Thirty Years with the Philippine Head-Hunters. By Samuel E. Kane in collaboration with Clarence H. Larmore. Grosset and Dunlap Publishers, New York, 1933. 331 pp., illus. Price, $1.

This book deals with the personal experiences of the author, who stayed 30 years among the pagan ethnological groups of northern Luzon. His long stay in that region made him familiar with the various typical customs and beliefs of these groups, such as their trial marriage, head-hunting, dog-eating, and their

canyao or ceremonial feast. The author is likewise familiar with the Mohammedan custom of running amuck in Mindanao. The book which carries several illustrations is written in plain and simple language, and is of particular interest to students of Philippine ethnography.—R. E. G.

Tobacco Diseases and Decays. By Frederick A. Wolf. Duke University press, Durham, North Carolina, 1935. 454 pp., illus. Price, $5.

This volume is the most comprehensive treatise ever written on the subject. It will doubtless serve as an excellent guide for tobacco growers in the identification of most, if not all, diseases affecting their crops and in adopting the proper methods of control. In like manner it will be useful to agricultural advisers and superintendents in tobacco districts, and to students and researchers on tobacco diseases, in orienting themselves with their particular problems. It carries information covering not only diseases prevalent in the fields but also decays to which tobacco is susceptible during curing, during fermentation and storage, and after its manufacture into cigars and cigarettes. Hence this book is likewise of value to cigar manufacturers.—F. B. S.

ERRATUM

VOLUME 61

Page 447, *for* Rollin G. Meyers, the author, *read* Rollin G. Myers.

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Memorial Supplement

TO

The Philippine Journal of Science

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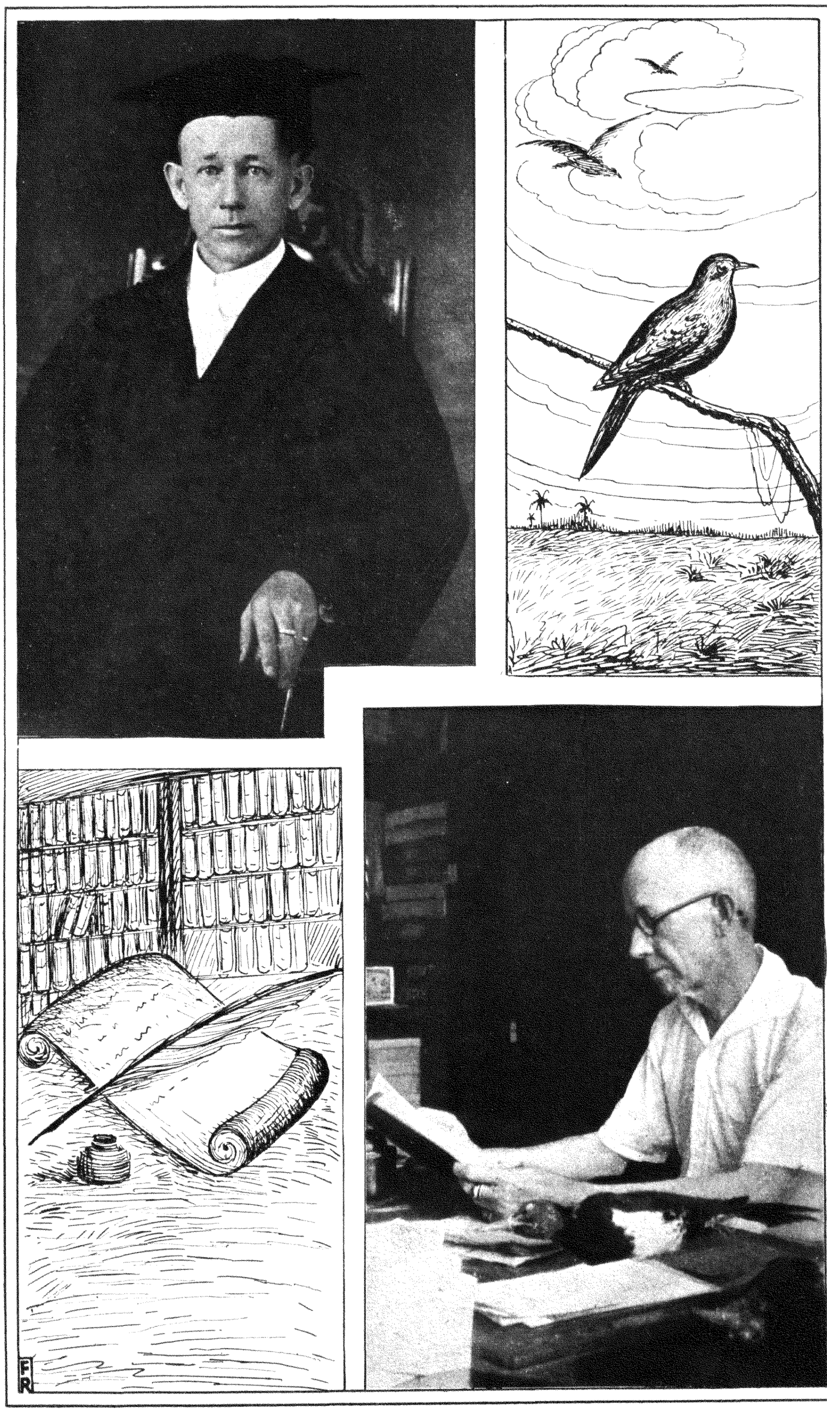

RICHARD CRITTENDEN MCGREGOR, 1871–1936

A Tribute

RICHARD C. McGREGOR came to the Philippines as a young man in the early years of the American régime over thirty years ago. He belonged to that small group of American scientists who came as pioneers in a tropical land so rich in flora and fauna. By dint of hard work and persistent effort, together with unbounded enthusiasm as a naturalist, he accumulated valuable data and knowledge on Philippine birds. After a career of three decades he became recognized as the foremost authority on ornithology in this part of the world. In those early years Filipino scientists were small in number and limited in experience. Now he leaves behind him a large group of Filipino scientists with broad experience who have been his colleagues at one time or another. McGregor has been characterized as an efficient public servant and as scientist of a high order. His passing is a loss to the scientific work in the Islands, and he is mourned by his colleagues as a sincere and devoted friend.

A. S. ARGUELLES
Director, Bureau of Science

6495

RICHARD C. McGREGOR, THE JOURNALIST

[Address delivered at the Necrological Service, January 12, 1937]

By EDUARDO R. ALVARADO

Assistant Chief, Publications Division, Department of Agriculture and Commerce, Manila

We are gathered here today, bowed in sorrow, to pay our last homage to Richard C. McGregor, the scientist and journalist.

I had the privilege of working with him for the last four years, and during this intimate association I have come to realize that a man can be great without the pomposity and popular acclaim that generally accompany modern greatness. For McGregor was great in his own modest and unobtrusive way. His greatness lies in the fact that he devoted the last half of his life to a field of human endeavor not appreciated and almost unknown in this country—scientific journalism; yet, without aiming at fame, through painstaking effort, assiduity, his love of the work itself, and in spite of the physical handicaps with which he was afflicted during the last years of his life, he was rated, by common accord among scientists, as the foremost scientific journalist in the Philippines, and one of the most renowned in the world.

He set a high standard for Philippine scientific literature, thus establishing the Philippine reputation for research and investigation throughout the scientific world. The PHILIPPINE JOURNAL OF SCIENCE, of which he was the managing editor during the last thirty years, takes its place among the best scientific periodical literature of the world, and constitutes in itself a monument to his devotion to his work. Every page of the Journal of Science bears the stamp of McGregorian simplicity, thoroughness, scientific accuracy, and painstaking labor.

His devotion to duty, which was an obsession to him; his thoroughness in the performance of his

work; his human understanding in dealing with his co-workers; his keen sense of modesty; his sincerity and honesty of purpose; and his serenity, fortitude, and sense of humor in adversity—these are priceless traditions that McGregor left to those who will carry on his work.

In his lifetime he daily devoted fourteen hours to his work; and in 1934, when he was laid up for over five months, he worked on his bed in the hospital. Even in his last hours, his work was uppermost in his mind. Twenty-four hours before he died he sent me word that he would be back to the office the following day.

In editing scientific papers he was punctiliously and scrupulously thorough to the last detail—no slip-shod methods for him. No error was too trivial to receive his careful attention. I have known him to spend hours and hours consulting reference books and previous works just to check a short statement of fact. To him a mistake was a mistake, and no careful editor should pass it over without having done everything possible to have it corrected. His favorite remark was, "I would rather have the JOURNAL OF SCIENCE come out a few days or a week late without any mistake than to have it come out on time full of mistakes. In the first case, a high standard of dependability is maintained; in the latter case, mistakes and misinformation are perpetuated."

His kindliness and his human understanding of the point of view, even the shortcomings, of the other fellow, will indeed be missed by his co-workers. In the Department of Agriculture and Commerce Publications Division, of which he was the chief, he was never known to treat his subordinates with condescension, nor did he exercise the stern and rigid authority that a superior usually exercises over subordinates. He considered his subordinates as his collaborators. The atmosphere of cheerfulness, friendliness, and coöperation radiating from the Chief pervaded the whole office personnel. Thus he was loved and respected by every employee.

I have yet to meet a man who is as modest and simple as McGregor was. Very few knew that he corresponded with famous men in different countries, among whom are renowned ornithologists, entomologists, scientific workers in all fields, as well as scientific publishers and editors. King Leopold of Belgium and former Governor-General Theodore Roosevelt were among his numerous friends abroad. He never took advantage of these influential connections to project himself to importance and fame in the columns of the daily press.

In this age, when it is the fashion in all countries and in all climes to go after public offices of honor irrespective of the necessary qualifications therefor, it is edifying and inspiring to turn a leaf in the life of McGregor, and learn a lesson in honesty to oneself and to the community. I have it on good authority that in the early days of the American régime he was offered high executive positions in the Government. In every case he declined the tender of appointments. When, in one of our daily chats of sundry things, I asked him why he did not accept these offers, he told me, dismissing the matter as trivial, that there were others who, in his opinion, were better qualified and had the necessary prestige for the positions, and that he was more useful to the Government as editor of the JOURNAL OF SCIENCE than as Bureau Director. What a precious lesson in self-evaluation!

Since his confinement in the hospital in 1934, McGregor had been a sick and suffering man. But never was he heard to complain of his sufferings nor of his physical invalidism which resulted from his illness. He was cheerful as usual. While a man of ordinary moral fiber would have despaired and brooded over his sufferings and physical invalidism, McGregor bore his ailments and handicaps with manly serenity and fortitude, immersing himself in his work with assiduous intensity. Not only this, but his sense of humor never dimmed in his hours of suffering. Late in 1935, when his ailment recurred and he had to be taken again to the hospital, he wrote me a note saying, "The old machine is creaky

again and had to be taken to the shop. As soon as it is properly overhauled and oiled it will be back on the job."

Thus lived a simple, kind-hearted, and hardworking honest man. Whatever we say here as a tribute to his memory will not add to the luster of the work, the example he set us, and the tradition he left behind him. Our feeble attempt to give a portrayal of his virtues may be likened to a futile attempt to add, with the dim light of a candle, to the brilliance of daylight.

May Richard C. McGregor join his virtuous kind in the presence of the Greatest Scientist—his Maker.

RICHARD CRITTENDEN McGREGOR, THE NATURALIST

[Address delivered at the Necrological Service, January 12, 1937]

BY CANUTO G. MANUEL
Assistant Ornithologist, Bureau of Science, Manila

Richard Crittenden McGregor was born in Sydney, Australia, on February 24, 1871, and died at the Manila Sanatorium December 30, 1936, of pernicious anemia, after an illness of about two years.

Already in his early days McGregor had manifest interest in natural history. His early observation on birds are recorded in THE AUK.

After graduating from Stanford University in 1898, McGregor set out with an expedition to Panama. Later, he joined the U. S. Coast and Geodetic Survey. It was during this period that he came to the Philippines—the land he adopted and the country that loved him. He accepted a position with the Philippine Government in 1901 and worked here continuously and faithfully until his death. Apparently, his motto was "Live to Work." His only avocation was collecting stamps.

With McGregor's long and varied experience, and the faithfulness with which he carried out any task assigned to him, he made a name both for himself and for the institution with which he worked. During the many years he served as ornithologist of the Bureau of Science he acquired an international reputation as the foremost authority on Philippine birds. He collected extensively throughout the Archipelago and published the results of his field experiences. As in the case of other naturalists, his interest was not limited to birds. Of the numerous Philippine plants and animals that first passed through his hands before becoming known to science many bear his name. The labors of McGregor in the Philippines as ornithologist are symbolized in the collection of

birds of the Philippine Bureau of Science which he had built and maintained for many years, and are largely recorded in the PHILIPPINE JOURNAL OF SCIENCE of which he was the managing editor. His MANUAL OF PHILIPPINE BIRDS is a classic among ornithological works.

McGregor was elected associate member of the American Ornithologists' Union in 1889, and in 1907 was granted a Life Fellowship. The latter honor is given only to a few distinguished ornithologists. He was also a charter member of the National Research Council of the Philippines and of many other scientific societies.

Although McGregor was of a somewhat retiring nature he was very courteous and approachable. Although a journalist by profession, he never liked publicity for himself, and many newspaper reporters were disappointed on interviewing him. He never ventured opinions where he was not certain of his facts. To his friends and colleagues he was ever a delightful companion, and the pleasant hours spent in his company will long remain in the memory of the many friends who mourn his passing.

RICHARD C. McGREGOR'S CONTRIBUTIONS TO SCIENCE

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1903. On birds from Luzon, Mindoro, Masbate, Ticao, Cuyo, Culion, Cagayan, Sulu, and Palawan. Manila, Bureau of Printing. Bulletin of the Philippine museum No. 1.

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1922. Philippine birds for boys and girls, by R. C. McGregor and E. J. Marshall. Manila, Bureau of Printing.

1928. Distribution of life in the Philippines, by Roy E. Dickerson in collaboration with Elmer D. Merrill, Richard C. McGre-

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1906. Notes on four birds from Luzon and on a species of doubtful occurrence in the Philippines. Philippine Journal of Science 1: 765–766.

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1906. Notes on a collection of birds from the Island of Tablas. Philippine Journal of Science 1: 771–777. Plates.

1906. Notes on a collection of birds from Palawan Island. Philippine Journal of Science 1: 903–908.

1907. Notes on a collection of birds from the Island of Basilan with descriptions of three new species. Philippine Journal of Science § A 2: 279–291.

1907. The occurrence of Blyth's wattled lapwing and the Scaup duck in the Philippine Islands. Philippine Journal of Science § A 2: 295.

1907. Notes on a bird unrecorded from Mindanao. Philippine Journal of Science § A 2: 296.

1907. Notes on specimens of the monkey-eating eagle (Pithecophaga jefferyi) Grant from Mindanao and Luzon. Philippine Journal of Science § A 2: 297.

1907. Notes on birds collected in Cebu. Philippine Journal of Science § A 2: 298–309. Tables.

1907. Birds observed in Bantayan Island, Province of Cebu. Philippine Journal of Science § A 2: 310–314.

1907. The birds of Bohol. Philippine Journal of Science § A 2: 315–335. Plate.

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1910. Birds from Pauai and Mount Pulog, subprovince of Benguet, Luzon. Philippine Journal of Science § D **5**: 135–138.

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1910. Notes on the migration of the tic-wee buzzard in the Philippine Islands. Philippine Journal of Science § D **5**: 199–201. Plate.

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1912. Bamboo for paper pulp in Bataan Province, Luzon. Philippine Journal of Science § A **7**: 121–125. Map.

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1927. Philippine fully-webbed swimming birds. Philippine Education magazine 23: 482–483, 518–519. Illus.

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1927. Philippine cuckoos, barbets, woodpeckers and broadbills. Philippine Education magazine 24: 70–71, 94–96. Illus.

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THE PHILIPPINE JOURNAL OF SCIENCE

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